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Assessment of Divisions 4VWX and Subarea 5 Pollock (*Pollachius virens*)

by

M.C. Annand, D. Beanlands and J. McMillan
Marine Fish Division
Department of Fisheries and Oceans
P.O. Box 1006
Dartmouth, N.S. B2Y 4A2

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Abstract

The 1987 catch fell almost 2,000 t below that of 1986 to 66,349 t, the drop being caused by a 4,000 t decrease in landings by the USA otter trawler fishery in Division 5Y. The movement of the pollock fishery from 4W to 4V during 1985 and 1986 has continued in 1987. Research survey indicies although variable indicate a relatively high mature stock abundance for 1988 with a lower abundance of younger fish. No above average year classes have been observed in the population since 1982. Commercial catch rates have been highly variable since 1982 with the 1987 catch rate back to the 1985 level. Both the research vessel (RV) population numbers at age and the commercial CPUE were used to calibrate the cohort analysis using both age by age (RV) and age aggregated (commercial) nonlinear least squares to estimate fishing mortalities. The F for 1987 was 0.33. Catch projections indicate that if a catch of 63,000 t is taken in 1988, this would result in a $F_{0.1}$ catch in 1989 of 42.5 kt. Application of the 50% rule would give a catch of 49.4 kt.

Résumé

La prise de 1987 a diminué à 66 349 t, soit presque 2 000 t de moins qu'en 1986; la baisse est attribuable à une diminution de 4 000 t des débarquements enregistrés par la flotte américaine de chalutiers à panneaux dans la Division 5Y. Le déplacement de la pêcherie du goberge de 4W à 4V observé en 1985 et 1986 s'est poursuivi en 1987. Les relevés par navire de recherche, bien que variables, indiquent une abondance relativement élevée du stock mature en 1988 et une abondance plus faible de poissons plus jeunes. Aucune classe d'âge supérieure à la moyenne n'a été observée dans la population depuis 1982. Le taux de prise de la pêche commerciale a été hautement variable depuis 1982, celui de 1987 étant revenu au niveau de celui de 1985. Les chiffres de population à l'âge provenant des navires de recherche (NR) ainsi que les PUE commerciaux ont tous deux été utilisés pour étalonner l'analyse par cohorte en utilisant la méthode des moindres carrés non linéaires, à la fois selon l'âge individuel (NR) et selon l'âge regroupé (commercial) pour estimer la mortalité par pêche. La F de 1987 était de 0,33. Les prévisions des prises indiquent que si la prise de 63 000 t se réalise en 1988, la prise à $F_{0,1}$ en 1989 sera de 42,5 kt. L'application de la règle de 50 % nous donnerait une prise de 49,4 kt.

Introduction

Since 1960, Canada and the USA have been the major participants in the pollock fishery and have consistently accounted for the largest share of the landings. Distant water fleet (DWF) catches of pollock have been primarily incidental, with the major share taken by USSR trawlers fishing for silver hake and other groundfish on the central and southern Scotian Shelf. Since the extension of jurisdiction in 1977, catches by DWF vessels have generally averaged less than 1,000 t annually. Preliminary estimates of nominal catch for 1987 indicate a drop from 68,074 t in 1986 to 66,349 t in 1987 (Table 1, Figure 1). Spatially most of the catch has been taken in Division 4X and Subarea 5 with a smaller proportion being taken in divisions 4VW (Figure 2). Within the divisions 4VW fishery there has been a trend since 1985 for a greater proportion of the catch to be taken in Division 4V than Division 4W (Table 2).

Catches by Canadian vessels are taken mainly by large offshore trawlers on the northern and central Scotian Shelf and Georges Bank, and by smaller vessels inshore using both mobile and fixed gear on the southwestern Scotian Shelf and eastern parts of the Gulf of Maine and Georges Bank. Seasonal breakdowns (Table 3) indicate a year-round fishery although with a bias toward summer and early fall in Division 4X and Subarea 5. The Canadian catch is broken down by gear, area, and season in Table 4. There was a significant increase in the Division 4X and Subarea 5 tonnage class 4 and over (TC 4+) trawler catch in 1987 which, since 1984, had been taken almost exclusively in divisions 4VW. Unconfirmed reports from industry indicate this may be due to high catch rates and fishing underutilized enterprise allocations. Nominal catches of both the inshore trawler fleet (TC 1-3) and the fixed gear fleet (TC 1+) dropped slightly.

USA catches are taken primarily in Subarea 5 by large trawlers in the Georges Bank area and by small trawlers and gillnetters in the Gulf of Maine region. No USA catches have been taken in divisions 4VW since 1979 (Table 3). Nominal catches by gear, area, and season are given in Table 5. There was a substantial decrease by the small otter trawler fleet in Division 5Y while other gear sectors remained relatively constant. The catch by the recreational fishery in the USA has been estimated via interviews from 1978-1987 (Table 6). Except for 1982 and 1983, the mean weight of recreationally caught pollock has been less than 0.5 kg suggesting most of the catch is comprised of harbour pollock. The high weights observed for 1982 and 1983 suggest that they may have been three and four year olds from the large 1979 year class. The 1982 year class, also thought to be above average, has not resulted in a comparable weight increase in the recreational fishery.

The 1987 Canadian allocation of 43,000 t was exceeded by 2,309 t. A description of the fishery, its allocations, regulations, and associated catch is presented in Table 7. For 1988, mobile gear and fixed gear <65 ft have been divided into two categories: a) mobile and fixed gear <45 ft and b) mobile and fixed gear 45-65 ft. Seasonal quotas and trip limits were introduced in 1986 for mobile gear under 65 ft in order to extend the fishery to the end of the year. As applied to the mobile gear <45 ft these seasonal

quotas are to allow a larger portion of their catch to be taken in summer months when they are less subject to weather conditions. The fixed gear <65 ft gear sector exceeded its 1987 quota by 2,300 t. Quotas would have been exceeded by the <65 ft mobile gear fleet if not for reallocation of quota from a short-fall in the Subdivision 3Ps <65 ft mobile gear fishery. It should be noted that divisions 4VWX + Subarea 5 is considered a separate management unit from Subdivision 3Ps and as such should preclude the transfer of quota between these units.

Distribution maps of catch per unit effort as recorded from the International Observer Program on Canadian vessels in 1980-1987 are shown in Figure 3. These maps show a shift from predominantly a Division 4X and Subarea 5 fishery in 1980 to an almost entirely Subdivision 4VS fishery in 1986. In the January-June and the July-December period of 1987, the distribution of fishing effort was more extensive than in the 1983-1986 period consistant with the increased catch by the large otter trawlers in Division 4X and Subarea 5.

Catch-at-Age

Sampling in 1987 was good for most gears (Table 8). Seasonal age length keys were generated for TC 4+ otter trawlers by area (4VW, 4X+5) and annual keys for both small trawlers TC 1-3 and fixed gears for the entire area (4VWX+5). Length-weight parameters were obtained from analysis of 1987 summer groundfish survey collections. Input data for generating the eight keys used for the Canadian catch-at-age is given in Table 9. These keys accounted for 45,308 t or 68% of the entire catch, the difference consisted of American catch and foreign by-catch. The USA 1987 catch-at-age and weight-at-age were supplied by NMFS (pers. comm. R. Mayo), while the age composition of the foreign by-catch was based on proportions and weight-at-age from the STRAP system. The combined total catch-at-age reflects the total landings (66,349 t of pollock in divisions 4VWX and Subarea 5). The total catch-at-age for 1970 to 1987, as well as the Canadian and American components, is given in Table 10. The 1987 catch-at-age was dominated by the 1980-1983 year classes (ages 4 to 7) which accounted for 80% of the catch numbers and 76% of the catch biomass (Table 11). The 1982 year class was strongest in all gear/area components of the total catch-at-age with the exception of the large otter trawlers in divisions 4VW where the 6 year old 1981 year class was stronger. The 1979 year class at age 8 was 9% of the total catch-at-age which is the highest observed since 1970.

A comparison of the observed and projected 1987 catch-at-age indicates close agreement for most ages (Figure 4). The observed catch of age 3 fish (1984 year class) was small compared to the projected as was the catch of 7 and 8 year old fish (1980 and 1979 year classes). Most of the differences in the percentage catch-at-age are due to an over-estimation of the 1984 year class (age 3) with a compensory under estimation of the older ages (4-6). For ages 4, 5, and 6 (the 1983, 1982, and 1981 year classes) more fish were caught than projected with the American component catching more 3 and 4 year old fish while the Canadian component caught more 6 and 7 year old fish.

The Canadian catch-at-age was also dominated by the 1980-1983 year classes accounting for 85% of the catch numbers and 81% of the biomass (Table 12), while the American catch-at-age was dominated by the 1981-1984 year classes which accounted for 68% of the catch numbers and 49% of the catch biomass (Table 13). The Canadian catch selects considerably more older fish than the American catch and is less concentrated on a single year-class (Figure 5).

Looking at the Canadian large trawler catch we see a substantial difference in age composition between divisions 4VW and Division 4X and Subarea 5 (Figure 6). In Division 4X and Subarea 5, 78% of the catch taken was composed of age 3, 4, and 5 fish with ages 6, 7, and 8 making up only 13% of the total. In divisions 4VW, 39% of the catch taken was composed of 3, 4, and 5 year old fish while 60% was composed of ages 6, 7, and 8. It is possible that this difference in catch at age trends is due to strong year classes (1982) recruiting first to the fishery in Subarea 5 and then later in divisions 4VWX. The American catch age composition is similar to the large otter trawler fleet in Division 4X and Subarea 5.

Mean Weights at Age

Mean weights at age corresponding to the total, Canadian and USA catch at age are given in Table 14. For the Canadian commercial fishery, weights for all age groups appeared to increase in the late 1970s and early 1980s. For ages 5, 6, 7, 8, and 9, weight at age appears to be decreasing since the early 1980s. Seasonal quotas may be partly responsible for this decrease, with most of the quota for the small otter trawlers being taken before August, thus landing smaller fish at age. In the USA commercial fishery, weights, though variable over the years, do not show any significant trends.

Survey mean weights at age were estimated by applying the appropriate length-weight coefficients to the 1970-1988 summer research survey using SMS software (O'Boyle and Wallace 1986) (Table 15). The survey results are quite variable overall but show some decrease in recent years. The 1987 weights are among the lowest recorded, although the 1988 weights show a return to pre-1987 levels indicating a possible problem with the 1987 length weight regressions used.

Abundance Indices

COMMERCIAL CATCH RATES

Scotia-Fundy and Newfoundland data 1974-1987 were analyzed using the multiplicative catch rate standardization (Gavaris 1980) in the APL workspace STANDAR. Because of unconfirmed industry reports which suggest that the catch and effort data for the TC 1-3 otter trawlers is unreliable, the standarized catch rate series was not used in assessing the population. It was noted however, that regression coefficients (Table 16) were high for the months December-March coinciding with the time pollock would be aggregated for spawning.

Commercial catch per unit of effort (CPUE) indicies were calculated for Canadian TC 5 otter trawlers where pollock was recorded as the main species for the trip. Computations were performed on an annual basis for the period April-November, rather than the June-August period used in the previous assessment. This avoids increases in availability due to spawning aggregations (December-March) which could cause high CPUE which are not indicative of stock size. This longer time period also smooths out some of the variability associated with the June-August catch rate series although the trends are very similar (Table 17, Figure 7). Trip limits imposed by government and industry since 1983 may also have an impact on the catch rate series possibly causing flucuations unrelated to stock size. The 1987 catch rate was 25% lower than the 1986 level.

Catch rates for April-November on a set by set basis (Table 18) were calculated from the International Observer Program (IOP) database for 1982-1987. The IOP series was consistently higher than the other although except for the 1985 point, trends were similar. Commercial landings data was checked for any obvious anomalies but none were found. The IOP catch rate series is too short to be used for calibration purposes but it may become useful as the time series is extended. The 1987 IOP value indicated a drop of approximately 40% from the 1986 level.

Research Surveys

Three vessels have been involved in the summer stratified random surveys of the Scotian Shelf (Figure 8) since 1970. After analyses of comparative fishing experiments, pollock catches were found to be the same between the different research vessels and hence no conversion factors were applied. The estimated total numbers at age from these surveys for Strata 40-95 are in Table 19 and the total abundance and ages 6 to 8 abundance are plotted in Figure 9. The total abundance for 1987 is the highest observed while the 1988 numbers are about half the 1987 value. For ages 6 to 8 the 1987 and 1988 numbers were almost equal, indicating a relatively high mature stock abundance for 1988 but a lower abundance of younger fish. This corresponds well with the passage through the population of the large 1979-82 year classes. Although the survey does not appear to track year classes very well, it does give some indication when they are strong. Both the 1979 and 1982 year classes showed up strong as 3 year olds. At the moment only the 1984 year class gives any indication of being above average. Mean numbers per tow by Strata (Table 20) indicate an increase in abundance in divisions 4VW since 1980 with abundance in Division 4X remaining relatively constant. This increase of abundance could be due to the appearance of strong and above average year classes during the 1979-1982 period. The mean weight per standard tow is given in Table 21.

Stratified random bottom trawl surveys (Figure 10) have been conducted in the USA by the Northeast Fisheries Center (NEFC) for spring and fall since 1968 and 1963, respectively (Table 22). Mean numbers per tow for 1988 (spring) are the lowest on record and mean weight per tow the second lowest. The exceptionally high 1987 value was due to 2 large tows composed of age 3 and 4 fish (Table 23). The 5+ numbers reached a peak in 1985 and have declined since, indicating a decline in mature stock abundance not observed

in the Canadian survey results. Aged numbers are not available for the 1988 survey.

The State of Massachusetts has surveyed the inshore waters of the Western Gulf of Maine since 1978. These surveys appear to be particularly suited to monitoring incoming recruitment given the proximity to the Gulf of Maine spawning grounds. Both the 1979 and 1982 year classes at age 1 were identified as being strong (Table 24). Nothing of that magnitude has been indicated in recent years. Given the limited area covered by this survey compared to the distribution of the stock as a whole, it is doubtful whether such indicies will accurately reflect trends in adult abundance.

Partial Recruitment

Partial recruitment was estimated for the 1979-1986 period from the ratio of Fs at younger ages to fully recruited Fs. The input PR and Ft were from last year's assessment. It was assumed that ages 7-11 were fully recruited. The Fs on the younger ages were divided by the 7+ average fully recruited F weighted by population numbers within each year. The annual PR vectors were then averaged across years and the resulting PR vector was adjusted so that the fully recruited mean was equal to 1. Age 6 could also be set to 1 in the PR calculation. The resulting PR vector PR87 indicated a slightly lower recruitment at age than last year (PR86).

Comparision of the current PR vector with that from the 1986 assessment is given below:

	Age									
	2	3	4	5	6	7	8	9	10	11
PR86	.038	.279	.592	.854	1.00	1.00	1.00	1.00	1.00	1.00
PR87	.029	.242	.546	.817	1.00	1.00	1.00	1.00	1.00	1.00

Calibration

As in last year's assessment, both the Canadian summer survey index and the commercial catch rate series were used in the calibration. Natural mortality was assumed constant at .2 for all ages and years. Cohort analysis of ages 2-11 from 1974 to 1987 was calibrated using ADAPT, an implementation of the adaptive framework of Gavaris (1988) (listing in Appendix I). The RV numbers at ages 6-8 were used to estimate fishing mortality at ages 7 and 8 in 1987. The Fs for ages 2-6 and 9-10 were based on the average of ages 7-8 and PR87 given above. The F for the oldest age group (age 11) was calculated as the weighted mean F for ages 6, 7, and 8. Because of generating extremely high fishing mortalities, age 6 in 1987 was given a zero weighting in the residuals matrix. CPUE was age aggregated for ages 2-11 with exploitable biomass calculated from annual PRs with fully recruited F based on ages 7 and 8. As in previous assessments, the 1982 CPUE was excluded from the calibrations. Standard errors were available for both series but proved

unusable. Log transformations were used to try and stabilize variance thus giving more weight to the 3 age segregated RV indicies than the single age aggregated CPUE index. The diagnostics from initial runs indicated that intercepts were not necessary in the age by age relationships between RV and SPA number or CPUE and fishable biomass. The ADAPT summary table is given in Table 25. The estimated numbers in 1987 were significant for ages 7 and 8 and the slopes were significant at all ages (Table 26, Figure 11). The estimate of fully recruited F in 1987 from ADAPT was 0.33.

The fishing mortality matrix, beginning of year population numbers, and mean population biomass, are given in Tables 27, 28, and 29, respectively.

Assessment Results

Recruitment

The average PR gave a very low population estimate for the 1985 year class in 1987. Therefore the 1987 age 2 numbers were set equal to the geometric mean of the 1974-1986 age two population numbers (40 million fish). The 1979-1982 year classes are all estimated to be above average and the 1979 and 1982 year classes are the largest in the time series. Since 1982 recruitment has dropped with no indication of any incoming strong year classes (Figure 12).

Age 2+ stock size reached a high in 1984 and has declined since while numbers for ages 6-8 have shown steady increases from 1974-1987 with the exception of a drop in 1983 and 1984 to the 1974 level (Figure 13). Age 2+ fishable biomass has risen from 1985 to 1987 second only to the 1984 peak (Figure 14). Biomass may have dropped in 1985 due to a drop in average Canadian weights at age.

Fishing mortalities have been variable throughout the entire time series (Figure 15) with the F in 1987 of 0.33 fairly close to the $F_{0.1}$ level of 0.28.

Prognosis

Catch projections to 1989 used the 1988 beginning of year population numbers, average weights from 1985-87 and a PR derived from fishing mortalities in the period 1985-87 assuming full recruitment at age 7. The 1987-88 year classes at age 2 were set equal to the geometric mean of the 1974-86 year classes of 40 million. Input data are given below:

Age	1988 Population (000's)	Weight-at-age (kg)	PR
2	40,000	0.74	.019
3	32,665	1.12	.162
4	15,423	1.91	.387
5	14,276	2.63	.648
6	22,043	3.22	.941
7	9,240	3.82	1.000
8	7,469	4.76	1.000
9	4,479	5.93	1.000
10	612	6.77	1.000
11	181	5.97	1.000

The results (Table 30) indicate that a catch of 63,000 t taken in 1988 will result in a terminal fishing mortality of 0.38 and an $F_{0.1}$ = .28 catch in 1989 of 42.5 kt. Application of the 50% rule would set the target F for 1989 to be 0.33 which would imply a catch of 49.4 kt in 1989.

References

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Table 1. Pollock landings (t round fresh) by country for divisions 4VWX and subareas 5 and 6, 1960 - 1986.

Year	Canada	Fed. Rep. Germany	German Dem. Rep.	Japan	Spain	USSR	United Kingdom	U.S.A.	Other	Total
1960	29470	-	-	-	783	-	-	10132	1	40386
1961	26323	-	-	-	982	-	-	10265	1	37571
1962	31721	-	-	-	-	-	-	7391	-	39112
1963	28999	126	-	-	-	906	28	6653	-	36712
1964	30007	208	-	-	-	4603	374	6006	55	41253
1965	27316	71	-	-	1361	2667	11	5303	-	36729
1966	18271	-	-	-	2384	9865	12	3791	-	34323
1967	17567	-	-	-	1779	644	1	3312	14	23317
1968	18062	-	-	-	1128	372	-	3280	7	22849
1969	15968	1188	2195	-	1515	227	-	3943	7	25043
1970	10753	3233	4710	40	532	527	-	3976	-	23771
1971	11757	633	6849	15	912	2216	-	4890	3	27275
1972	18022	475	4816	8	616	3495	4	5729	54	33219
1973	26990	1124	948	1570	3113	3092	-	6303	36	43176
1974	24975	149	2	40	1500	2348	48	8726	14	37802
1975	26548	236	96	-	709	2004	-	9318	124	39035
1976	23568	994	24	-	303	1466	-	10863	390	37608
1977	24654	368	-	1	2	268	-	13056	53	38402
1978	26801	-	-	110	-	502	-	17714	180	45307
1979	29967	7	-	19	-	1025	-	15541	73	46632
1980	35986	-	-	81	-	950	-	18280	131	55428
1981	40270	-	-	15	-	358	-	18171	90	58904
1982	38029	-	-	3	-	297	-	14357	128	52814
1983	32749	-	-	6	-	226	-	13967	283	47231
1984	33465	-	1	1	-	97	-	17903	169	51636
1985	43300	-	-	17	-	336	-	19457	143	63253
1986	42975*	-	-	51	-	564	-	24348	136	68074
1987	45308*	-	-	84	-	314	-	20251	392	66349

* Data from DFO Statistics Branch, provisional data for countries other than Canada.

Table 2. Pollock landings (t, round fresh) for divisions 4VWX, Subarea 5 and Statistical Area 6, 1960-1986 (1987 data not available).

Year	4V	4W	4X	5Y	5Z	SA6 +SNK	Total 4VW	Total 4X+5+6	Total
1960	1503	8354	20132	6545	3834	18	9857	30529	40386
1961	1864	13167	14321	5017	3177	25	15031	22540	37571
1962	1292	12045	19624	2560	3576	15	13337	25775	39112
1963	674	9152	20645	2168	3947	126	9826	26886	36712
1964	474	12488	19283	1754	7250	4	12962	28291	41253
1965	1205	13134	13390	1933	7065	2	14339	22390	36729
1966	788	11040	12648	953	8846	48	11828	22495	34323
1967	657	5836	8290	1728	6790	16	6493	16824	23317
1968	1013	5954	10656	1416	3806	4	6967	15882	22849
1969	300	3938	10983	4635	5187	-	4238	20805	25043
1970	649	2952	8194	6281	5280	415	3601	20172	23771
1971	531	1802	9739	7016	7238	949	2333	24942	27275
1972	597	3419	16190	6419	6570	24	4016	29203	33219
1973	1004	5871	23225	5202	7853	21	6875	36301	43176
1974	307	4740	20362	6106	6238	49	5047	32755	37802
1975	799	5697	18668	6015	7851	5	6496	32539	39035
1976	1102	3424	19700	6441	6926	15	4526	33082	37608
1977	1347	6082	14700	8278	7925	70	7429	30973	38402
1978	2931	4910	15161	12238	9960	107	7841	37466	45307
1979	4877	4963	18340	9856	8367	229	9840	36792	46632
1980	3893	7511	20485	11388	11903	248	11404	44024	55428
1981	2316	15678	18842	12475	9319	274	17994	40910	58904
1982	2939	9373	21036	9416	9918	132	12312	40502	52814
1983	5491	5787	18137	8458	9242	116	11278	35953	47231
1984	5474	6043	19486	12543	7847	243	11517	40119	51636
1985	12085	3262	26837	15615	5188	266	15347	43906	63253
1986**	14945	2998	23119	18882	7377	2	17943	49380	68074*
1987**	12710	3762	25710	15969	7404	-	16864*	49083	66349*

* includes NK

** Data from DFO Statistics Branch, provisional data for countries other than Canada.

Table 3. Pollock landings (t round fresh) by season and country for NAFO Divisions 4VWX-5-6.

Canada (Maritimes & Newfoundland)

	4VW				4X+5			
Year	Jan-Apr	May-Aug	Sept-Dec	Total	Jan-Apr	May-Aug	Sept-Dec	Total
1970	1531	258	362	2151	1075	4800	2727	8602
1971	633	181	280	1094	1169	6160	3334	10663
1972	417	236	716	1369	2006	8762	5885	16653
1973	732	377	2314	3423	5190	13185	5192	23567
1974	713	1257	807	2777	1643	11738	8817	22198
1975	1223	1005	1854	4082	1836	9866	10764	22466
1976	425	845	1186	2456	2078	12170	6864	21112
1977	931	1428	4748	7107	6010	5880	5657	17547
1978	3875	2696	510	7081	5835	7484	6401	19720
1979	1406	5477	1927	8810	4558	10023	6576	21157
1980	2493	4301	3633	10427	6353	13188	6018	25559
1981	4056	2437	11055	17548	5792	7170	9760	22722
1982	3030	4082	4774	11886	3096	14664	8383	26143
1983	2029	7099	1644	10772	4879	14212	2886	21977
1984	2288	4744	4217	11249	2820	13900	5496	22216
1985	3861	5031	5959	14851	6589	15673	6187	28449
1986*	5503	8035	4403	17941	5840	14163	5031	25034
1987*	6182	5511	4780	16473	5771	16477	6587	28835

Table 3. (Continued)

U.S.A.

	4VW					4X+5				
Year	Jan-Apr	May-Aug	Sept-Oct	UK Mon.	Total	Jan-Apr	May-Aug	Sept-Dec	UK Mon.	Total
1970	13	26	-	-	39	1450	530	1942	16	3938
1971	22	-	-	-	22	1806	711	2346	5	4868
1972	32	4	15	-	51	1198	1214	3266	-	5678
1973	7	18	44	-	69	1442	1368	3422	2	6234
1974	6	30	9	-	45	2656	2051	3614	360	8681
1975	14	4	32	-	50	2527	2824	3502	415	9268
1976	76	3	2	2	83	2454	3753	3910	663	10780
1977	2	2	4	-	8	2954	4597	4753	744	13048
1978	5	-	-	-	5	4373	5078	7461	797	17709
1979	-	-	-	-	-	2888	5588	6225	840	15541
1980	-	-	-	-	-	3776	6110	7023	1371	18280
1981	-	-	-	-	-	5120	4915	7864	272	18171
1982	-	-	-	-	-	3257	4288	6624	188	14357
1983	-	-	-	-	-	3105	5752	4956	154	13967
1984	-	-	-	-	-	4632	5092	7900	279	17903
1985	-	-	-	-	-	7182	4655	7315	305	19457
1986**	-	-	-	-	-	7650	6881	9815	2	24348
1887**	-	-	-	-	-	5467	6726	8057	1	20251

* Data from DFO Statistics Branch.

** From data provided by NMFS data tapes.

Table 3. (Continued)

Foreign Catches (non USSR)

	4VW					4X+5				
Year	Jan-Apr	May-Aug	Aug-Sept	UK Mon.	Total	Jan-Apr	May-Aug	Sept-Dec	UK Mon.	Total
1970	622	1	311	-	934	1474	47	6059	-	7580
1971	622	8	26	-	656	1299	33	6424	-	7756
1972	443	20	76	44	583	622	21	4747	-	5390
1973	1079	40	1970	-	3089	778	1100	1824	-	3702
1974	170	166	164	-	500	533	481	239	-	1253
1975	407	53	231	-	691	41	86	347	-	474
1976	178	315	160	-	653	4	165	889	-	1058
1977	8	192	15	-	215	3	204	2	-	209
1978	31	153	95	-	279	-	5	6	-	11
1979	22	22	54	-	98	-	-	1	-	1
1980	101	38	1	-	140	-	8	64	-	72
1981	90	-	-	-	90	-	5	10	-	15
1982	23	106	-	-	129	1	-	1	-	2
1983	18	268	-	-	286	-	3	-	-	3
1984	87	83	1	-	171	-	-	-	-	-
1985	82	70	8	-	160	-	-	-	-	-
1986***	157	10	20	-	187	-	-	-	-	-
1987***	-	-	39	437	476	-	-	-	-	-

Table 3. (Continued)

USSR

	4VW					4X+5				
Year	Jan-Apr	May-Aug	Sept-Oct	UK Mon.	Total	Jan-Apr	May-Aug	Sept-Dec	UK Mon.	Total
1970	174	247	53	-	474	10	11	32	-	53
1971	160	186	215	-	561	1144	400	111	-	1655
1972	906	1098	9	-	2013	235	1163	84	-	1482
1973	129	165	-	-	294	1743	45	1010	-	2798
1974	194	903	628	-	1725	58	512	53	-	623
1975	471	981	221	-	1673	58	149	124	-	331
1976	555	488	291	-	1334	10	58	64	-	132
1977	17	82	-	-	99	125	44	-	-	169
1978	9	459	8	-	476	-	26	-	-	26
1979	4	928	-	-	932	6	87	-	-	93
1980	122	715	-	-	837	-	113	-	-	113
1981	45	311	-	-	356	2	-	-	-	2
1982	-	297	-	-	297	-	-	-	-	-
1983	16	204	-	-	220	-	6	-	-	6
1984	-	97	-	-	97	-	-	-	-	-
1985	-	336	-	-	336	-	-	-	-	-
1986***	-	564	-	-	564	-	-	-	-	-
1987***	-	314	-	-	314	-	-	-	-	-

Table 4. Nominal landings of pollock in NAFO divisions 4VW and 4X and Subareas 5 and 6 for Canadian (Maritimes, Quebec, and Newfoundland). Data for 1986 and 1987 are provisional.

OTB 1, 2 (TC 4+)

	4VW				4X+5+6			
Year	Jan-Apr	May-Aug	Sept-Dec	Total	Jan-Apr	May-Aug	Sept-Dec	Total
1970	1523	212	138	1873	686	1865	1581	4132
71	629	63	208	900	919	3473	2073	6465
72	417	90	545	1052	1461	5800	4138	11399
73	726	276	2173	3175	3259	4227	3239	10725
74	707	1113	628	2448	1057	6350	5964	13371
75	1222	926	1776	3924	1042	5699	5361	12102
76	424	737	1081	2242	877	5418	2746	9041
77	912	1358	4545	6815	4846	1522	2661	9029
78	3558	2107	377	6042	4676	3383	2411	10470
79	1368	5194	1715	8277	3487	3421	1004	7912
1980	2448	3949	3412	9809	4321	3409	2411	10141
81	3980	1382	9017	14379	4280	558	4956	9794
82	2919	3084	4123	10126	1628	3917	3665	9210
83	1879	6144	1032	9055	2890	2652	396	5938
84	2155	3416	3559	9130	729	1633	564	2926
85	3628	4339	5502	13469	581	835	879	2295
86	4861	6499	3957	15317	1326	939	235	2500
87	5609	4178	3998	13785	2435	2518	2408	7361

OTB 1, 2 (TC 1-3)

	4VW				4X+5+6			
Year	Jan-Apr	May-Aug	Sept-Dec	Total	Jan-Apr	May-Aug	Sept-Dec	Total
1970	8	0	0	8	336	2042	483	2861
71	4	0	0	4	245	1708	717	2670
72	0	9	1	10	537	2035	902	3474
73	0	0	2	2	1922	6762	618	9302
74	0	39	40	79	562	3398	591	4551
75	0	0	0	0	745	2610	836	4191
76	0	0	0	0	1039	2844	715	4598
77	0	2	0	2	896	2224	808	3928
78	9	23	2	34	955	2187	961	4103
79	0	8	2	10	869	4043	1170	6082
1980	2	137	18	157	1523	4033	823	6379
81	32	302	44	378	957	3178	1547	5682
82	58	220	93	371	713	4775	1734	7222
83	84	155	23	262	1403	6829	855	9087
84	119	598	252	969	1847	8492	3015	13354
85	197	151	89	437	5408	8564	1386	15358
86	379	804	44	1227	3797	4801	594	9192
87	504	311	73	888	2747	5859	483	9089

Table 4. (Continued)

GN LL and Other Gears (TC 1-6)

Year	4VW				4X+5+6			
	Jan-Apr	May-Aug	Sept-Dec	Total	Jan-Apr	May-Aug	Sept-Dec	Total
1970	0	46	224	270	53	893	663	1609
71	0	118	72	190	5	979	544	1528
72	0	137	170	307	8	927	845	1780
73	6	101	139	246	9	2196	1335	3540
74	6	105	139	250	24	1990	2262	4276
75	1	79	78	158	49	1557	4567	6173
76	1	108	105	214	162	3908	3403	7473
77	19	68	203	290	268	2134	2188	4590
78	308	566	131	1005	204	1914	3029	5147
79	38	275	210	523	202	2559	4402	7163
1980	43	215	203	461	509	5746	2784	9039
81	44	753	1994	2791	555	3434	3257	7246
82	53	778	558	1389	755	5972	2984	9711
83	66	800	589	1455	586	4731	1635	6952
84	14	730	406	1150	244	3775	1917	5936
85	36	541	368	945	600	6274	3922	10796
86	264	732	403	1399	716	8422	4202	13340
87	69	1022	709	1800	589	8100	3696	12385

Table 5. US pollock catches for subareas 3, 5 and 6 and divisions 4VWX. (From data provided by NMFS.)

OTB (TC 2, 3)

	5Y				5Z				4VWX + 3 + 6			
Year	Jan-Apr	May-Aug	Sept-Dec	Total	Jan-Apr	May-Aug	Sept-Dec	Total	Jan-Apr	May-Aug	Sept-Dec	Total
1970	226	107	310	643	243	151	401	795	21	23	72	116
1971	267	95	519	881	332	177	743	1252	10	6	21	37
1972	226	120	1670	2016	426	233	400	1059	1	15	54	70
1973	258	314	1345	1917	395	256	567	1218	19	31	1	51
1974	632	325	1497	2454	506	505	391	1402	36	-	52	88
1975	562	277	847	1686	389	645	573	1607	32	35	52	119
1976	336	581	1058	1975	598	803	862	2263	10	67	-	77
1977	488	551	1036	2075	735	1443	942	3120	2	21	56	79
1978	964	533	1338	2835	859	1383	1255	3497	9	-	5	14
1979	412	488	698	1598	597	1553	1127	3277	-	3	-	3
1980	756	825	1274	2855	889	1847	836	3572	-	-	-	-
1981	981	539	1609	3129	937	1196	592	2725	-	7	8	15
1982	583	784	1237	2604	941	802	1168	2911	28	28	5	61
1983	427	1075	1000	2502	707	1006	536	2249	36	71	16	123
1984	1080	862	1735	3677	955	938	483	2376	35	62	31	128
1985	2716	1234	1522	5472	742	935	423	2100	2	3	18	23
1986	2812	2395	1973	7180	800	908	901	2609	48	26	34	108
1987	1186	1328	1188	3702	580	1033	394	2007	16	-	4	20

OTB (TC 4+)

	5Y				5Z				4VWX + 3 + 6			
Year	Jan-Apr	May-Aug	Sept-Dec	Total	Jan-Apr	May-Aug	Sept-Dec	Total	Jan-Apr	May-Aug	Sept-Dec	Total
1970	200	25	129	354	675	80	625	1380	91	47	134	272
1971	223	16	107	346	906	258	553	1717	94	7	27	128
1972	73	156	158	387	338	295	348	981	142	220	62	424
1973	147	69	257	473	241	263	305	809	361	76	74	511
1974	238	87	322	647	437	334	330	1101	345	193	52	590
1975	375	78	117	570	297	492	505	1294	443	79	100	622
1976	113	177	226	516	635	395	473	1503	240	210	91	541
1977	191	159	233	583	375	663	357	1395	81	58	103	242
1978	484	266	332	1082	495	517	691	1703	92	56	7	155
1979	250	411	360	1021	439	591	704	1734	42	23	50	115
1980	606	396	431	1433	500	801	865	2166	114	45	222	381
1981	232	418	542	1192	1111	606	707	2424	50	16	78	144
1982	329	825	675	1829	830	508	844	2182	102	40	64	206
1983	402	872	694	1968	1133	1124	1131	3388	198	139	69	406
1984	791	374	1311	2476	1020	1448	1309	3777	89	293	51	433
1985	2556	598	1171	4325	465	623	354	1442	46	11	96	153
1986	1785	1138	1179	4102	634	880	889	2403	76	39	14	129
1987	1674	970	1066	3680	799	1253	559	2611	30	37	14	81

Table 5. (Continued)

c) LL (TC 1-4+) and Other Gears (Combined)

	5Y				5Z				4VWX+5+3+6			
Year	Jan-Apr	May-Aug	Sept-Dec	Total	Jan-Apr	May-Aug	Sept-Dec	Total	Jan-Apr	May-Aug	Sept-Dec	Total
1970	2	48	25	75	2	36	16	54	-	-	-	-
1971	3	49	56	108	5	57	13	75	-	-	-	-
1972	11	33	18	62	3	32	10	45	-	-	-	-
1973	13	134	71	218	5	56	22	83	-	-	8	8
1974	23	46	44	113	20	55	24	99	-	-	-	-
1975	15	287	41	343	11	38	26	75	-	-	-	-
1976	21	49	14	84	39	29	5	73	-	-	-	-
1977	18	131	40	189	35	36	3	74	-	-	-	-
1978	18	96	5	119	35	157	99	291	-	-	-	-
1979	30	64	-	94	48	278	86	412	-	-	-	-
1980	16	16	241	273	109	106	-	215	-	-	-	-
1981	72	43	86	201	9	56	12	77	-	-	-	-
1982	12	11	7	30	16	29	14	59	-	-	-	-
1983	3	1	-	4	7	54	16	77	-	-	-	-
1984	-	1	-	1	22	24	4	50	-	-	-	-
1985	2	10	2	14	25	11	21	57	-	-	-	-
1986	-	1	23	24	4	8	15	27	-	-	-	-
1987	14	1	6	21	9	26	34	69	-	-	-	-

d) GN (TC 1-4+)

	5Y				5Z				4VWX+5+3+6			
Year	Jan-Apr	May-Aug	Sept-Dec	Total	Jan-Apr	May-Aug	Sept-Dec	Total	Jan-Apr	May-Aug	Sept-Dec	Total
1970	4	48	233	285	-	-	-	-	-	-	-	-
1971	2	41	310	353	-	-	-	-	-	-	-	-
1972	18	122	558	698	-	-	-	-	-	-	-	-
1973	16	192	766	974	-	-	60	60	-	-	-	-
1974	426	553	886	1865	-	-	38	38	-	-	-	-
1975	420	910	1283	2613	-	-	-	-	-	-	-	-
1976	541	1444	1192	3177	2	-	2	4	-	-	-	-
1977	1022	1534	1951	4507	6	6	40	52	-	-	-	-
1978	1408	2043	3725	7176	16	29	7	52	-	-	-	-
1979	1066	2056	2704	5826	5	140	339	484	-	-	-	-
1980	628	1674	2905	5207	171	408	261	840	-	-	-	-
1981	1461	1437	3810	6708	185	429	71	685	-	20	-	20
1982	398	1069	2556	4023	44	205	69	318	-	-	-	-
1983	186	1260	1460	2906	24	151	39	214	-	-	-	-
1984	595	944	2758	4297	51	162	224	437	-	-	-	-
1985	504	950	3496	4950	133	312	216	661	-	-	-	-
1986	1318	1104	4515	6937	172	381	272	825	-	-	-	-
1987	1053	1748	4638	7439	136	331	154	621	-	-	-	-

Table 6. USA recreational catches of pollock (numbers, total weight, and estimated mean weight in kilograms) as estimated from data collected in USA recreational fishery surveys.

Year	Number (000's)	Mean Weight (kg)	Catch Weight (tons)
1979	2,349 (3,648)	0.28	1,021 (658)
1980	1,997 (4,446)	0.48	2,134 (959)
1981	1,602 (2,724)	0.45	1,226 (721)
1982	882 (1,686)	1.52	2,563 (1,341)
1983	590 (1,314)	2.13	2,799 (1,257)
1984	205 (642)	0.43	276 (174)
1985	1,860 (2,147)	0.40	862 (747)
1986	359 (447)	0.49	219 (176)
1987	278 (741)	0.40	296 (111)

Numbers in parentheses include data for pollock caught and released alive; catch weights were calculated by multiplying numbers caught by mean weight of pollock estimated from an intercept (creel) survey.

Table 7. Description of the pollock fishery in 4VWX5 and its regulations 1973-1987.

Year	Fleet	Initial Allocation (t)	Final Allocation (t)	Reported Catch (t)	Percent Taken (%)	Dates (Closures (cl) Trip Limits (tl) Bycatch (bc)	Remarks
1973	All vessels 4X & 5	50.0K	50.0K	43.0K	78	—	mixed groundfish fishery 63% Can; 14% USA; 23% DWF
1974	All vessels-Canadian	34.0K	34.0K	-	-	—	Directed fishery
	All vessels-foreign	21.0K	21.0K	-	-		65% Can; 23% USA; 12% DWF
	Total 4VWX+5	55.0K	55.0K	38.0K	69		
1975	All vessels-Canadian	33.5K	33.5K	-	-	—	Directed fishery
	All vessels-foreign	21.5K	21.5K	-	-		67% Can; 23% USA; 10% DWF
	Total 4VWX+5	55.0K	55.0K	39.0K	71		
1976	All vessels-Canadian	33.5K	33.5K	-	-	—	Directed fishery
	All vessels-foreign	21.5K	21.5K	-	-		63% Can; 29% USA; 8% DWF
	Total 4VWX+5	55.0K	55.0K	38.0K	69		
1977	All vessels-Canadian	20.975K	20.975K	-	-	—	200 mile limit imposed
	All vessels-foreign	9.025K	9.025K	-	-		Directed fishery
	Total 4VWX+5	30.0K	30.0K	38.0K	127		65% Can; 34% USA; 1% DWF
1978	All vessels-Canadian	20.975K	20.975K	-	-	—	Directed fishery
	All vessels-foreign	9.025K	9.025K	-	-		60% Can; 40% USA; <1% DWF
	Total 4VWX+5	30.0K	30.0K	45.0K	150		
1979	All vessels-Canadian	22.32K	22.32K	-	-	—	Directed fishery
	All vessels-foreign	7.68K	7.68K	-	-		65% Can; 34% USA; <1% DWF
	Total 4VWX+5	30.0K	30.0K	47.0K	156		Treaty signed*
1980	All vessels-Canadian	22.32K	29.76K	-	-		Directed fishery
	FG	5.0K	4.76K	9.342K	196		65% Can; 34% USA; <1% DWF
	MG<125'	3.81K	9.0K	8.278K	92	cl 18/08-9/10;cl 09/11-31/12	Allocations based on
	MG>125'(1/1-14/10)	11.91K	12.10K	18.375K	115	cl 31/03- ? ;cl 12/07-15/10	treaty 74.4% Can, 24.6%
	MG>125'(15/10-31/12)	1.6K	3.90K			cl 16/11-31/12	Foreign
	All vessels-USA	7.68K	10.24K	18.3K	179		
	All vessels-foreign	-	-	0.2K	-		
	Total 4VWX+5	30.0K	40.0K	55.0K	137		
1981	All vessels-Canadian	29.76K	40.16K	-	-		Directed fishery
	FG	8.76K	9.3K**	9.8K	105		69% Can; 30% USA; <1% DWF
	MG<125'	7.0K	8.5K	7.2K	84		Allocation based on
	MG>125'(1/1-14/10)	10.5K	18.9K	23.8K	106	cl 15/04-15/10	treaty
	MG>125'(15/10-31/12)	3.5K	3.5K				
	Reserve	-	5.0K**				
	All vessels-USA	10.24K	13.84K	18.0K	130		
	All vessels-foreign	-	-	0.5K	-		
	Total 4VWX+5	40.0K	54.0K	59.0K	109		

* Treaty signed 29 March; was not ratified although allocation made accordingly; 74.4% Canada, 25.6% USA.

** Reserve assigned to fixed gear near end of year to give final allocation of 9.3K

Table 7. (Continued)

Year	Fleet	Initial Allocation (t)	Final Allocation (t)	Reported Catch (t)	Percent Taken (%)	Dates (Closures (cl) Trip Limits (tl) Bycatch (bc)	Remarks
1982	All vessels-Canadian	43.0K	43.0K	-	-		Directed fishery
	FG	10.5K	11.5K	10.9K	95		69% Can; 30% USA; <1% DWF
	MG>100'	24.0K	22.0K	19.0K	86		Vessels greater than 65'-
	MG 65'-100'	0.5K	0.5K	0.22K	44		sector management-company
	MG<65'	8.0K	9.0K	8.3K	92	cl 8/10-13/11	quotas
	All vessels-USA	12.0K	12.0K	14.3K	119		
	All vessels-foreign	-	-	0.4K	-		
	Total 4VWX+5	55.0K	55.0K	53.0K	96		
1983	All vessels-Canadian	40.0K	42.0K	-	-		Directed fishery
	FG	9.6K	10.69K	8.2K	77		70% Can; 30% USA; <1% DWF
	MG>100'	22.4K	21.4K	14.8K	69		(Dec) Companies
	MG 65'-100'	0.25K	0.28K	0.23K	82	cl 30/07	discouraged fishing for
	MG<65'	7.75K	9.63K	9.5K	99		pollock because of low
	All vessels-USA	5.0K	10.0K	14.0K	140		market value; 20,000 lb
	All vessels-foreign	-	-	0.5K	-		limit except if sold
	Total 4VWX+5	45.0K	52.0K	47.0K	90		fresh.
1984	All vessels-Canadian	42.4K	42.4K	-	-		Directed fishery
	FG	10.17K	8.97K	7.0K	78		65% Can; 35% USA; <1% DWF
	MG>100'	23.75K	19.45K	12.0K	62		Trip limits set by
	MG 65'-100'	0.27K	0.77K	0.65K	84		companies (IOP) vary from
	MG <65'	8.21K	13.21K	13.8K	104	Ent. Alloc. Pierce Fishery	20,000-200,000 lb
	All vessels-USA	10.6K	10.6K	17.7K	167	cl 17/10;4X cl 22/05-01/06;	
	All vessels-foreign	-	-	0.3K	-	cl 30/06-02/09	
	Total 4VWX+5	53.0K	53.0K	51.0K	96		
1985	All vessels-Canadian	42.4K	42.4K	-	-		Directed fishery
	FG	10.17K	8.37K	11.63K	139	<65' cl 16/11-28/11	No U.S. or foreign alloc.
	MG>100'	23.75K	17.35K	15.8K	91		Trip limits (IOP) imposed
	MG 65'-100'	0.27K	0.47K	0.42K	89		by companies vary from
	MG<65'	8.21K	16.21K	15.14K	93	27/07-20% bc; 13/08-10% bc;	30-125,000 lbs
	Total 4VWX+5	42.4K	42.4K	42.9K	101	30/08-35% bc; 16/11-10% bc.	
	All vessels-USA	-	-	19.3K	-		
	All vessels-foreign	-	-	0.42K	-		
1986	All vessels-Canadian	40.0K	40.0K	-	-		Directed fishery
	FG	11.0K	11.4K	14.4K	126	Class A-03/10-1500kg tl 10%	No U.S. or foreign alloc.
	MG>100'	20.0K	18.8K	18.1K*	96	bc to 31/12	Trip limits imposed by
	MG 65'-100'	0.25K	0.25K	0.38K	152	cl 13/09	companies 15-100,000 lbs
	MG<65'	8.75K**	9.55K	10.1K	106	28/03-4500kg tl; 8/04-0kg tl	
	Total 4VWX+5	40.0K	40.0K	43.0K	108	10% bc; 28/04-13600 tl;	
	All vessels-USA	-	-	24.0K	-	6/05-22500kg tl; 14/06-	
	All vessels-foreign	-	-	8.0K	-	4500kg tl; 23/06-1500kg tl;	
						18/07-1500kg tl or 10% bc;	
						26/08-0kg tl 10% bc; 1/09-	
						1000kg tl or 10% bc; 20/09-	
						0kg tl 10% bc to 31/12	

* 1.7K Newfoundland 16.2 Scotia Fundy

** Jan-Apr 1.3K; May-Aug 5.65K; Sept-Dec 1.8K - changed mid year - Jan-Apr 2.97K; May-Aug 5.26K; Sept-Dec 1.31K

Table 7. (Continued)

Year	Fleet	Initial Allocation (t)	Final Allocation (t)	Reported Catch (t)	Percent Taken (%)	Dates (closures (cl) Trip Limits (tl) Bycatch (bc)	Remarks
1987	All vessels-Canadian	44.5K	44.5K	-	-		Directed fishery
	FG<65'	11.825K	11.825K	14.096K	119	20/11-1500kg tl	
	MG>100'	21.5K	21.5K	20.959K	97		
	MG 65'-100'	0.27K	0.468K	0.479K	102	cl 24/03-31/03	
	MG<65' (Jan 1-Apr 30)	2.93K	2.962K	2.959K	100	1/01-9000kg tl; 03/02-9000kg tl; 20/02-4500kg tl; 12/03-0kg tl 10% bc	
	MG<65' (May 1-Aug 31)	5.175K	6.252K	6.234K	100	01/05-9000kg tl; 01/06-7000kg tl; 11/06-4500kg tl; 19/06-1500kg tl; 26/06-0kg tl 10% bc	
	MG<65' (Sept 1-Dec 31)	1.3K	0.562K	0.512K	91	01/09-900kg tl; 03/10-0kg tl 10% bc	
	3PS	1.5K**	0.931K	0.178K	19		
	Total 4VWX+5+3PS	44.5K	44.5K	45.417K	102		
	All vessels-USA	-	-	20.25K	-		
	All vessels-foreign	-	-	0.918K	-		
1988*	All vessels-Canadian	48.4K	-	-	-		Directed fishery Can. catches to Aug 10/88
	FG<45'	11.525K	11.525K	3.232K	28		
	FG 45'-64'	0.3K	0.3K	0.369K	123	16/07-1500kg tl 10% bc	
	MG>100'	21.5K	22.0K	11.302K	51		
	MG 65'-100'	0.275K	0.275K	0.056K	20		
	MG 45'-64' (Jan 1-Apr 30)	1.75K	1.75K	2.2K	126	19/03-4500 kg tl	
	MG 45'-64' (May 1-Aug 31)	3.1K	2.8K	3.378K	121	06/05-9000kg tl 10% bc; 01/06-4500kg tl 10% bc; 01/07-9000kg tl 10% bc	
	MG 45'-64' (Sept 1-Dec 31)	0.79K	0.79K	0.0K	0	01/08-4500kg tl 10% bc; 06/08-0kg tl 10% bc	
	MG<45' (Jan 1-Apr 30)	1.165K	1.165K	1.125K	97	19/03-6800kg tl	
	MG<45' (May 1-Aug 31)	2.07K	1.87K	2.578K	138	01/05-9000kg tl 10% bc; 23/07-6800kg tl 10% bc; 28/07-1000kg tl 10% bc	
	MG<45' (Sept 1-Dec 31)	0.525K	0.525K	0.0K	0	06/08-0kg tl 10% bc	
	3PS	5.4K	5.4K	1.013K	19		
	Total 4VWX+5+3PS	48.4K	-	25.253K	52		
	All vessels-USA	-	-	-	-		
	All vessels-foreign	-	-	-	-		

* As of August 10, 1988

** 3PS 1.5K Aug 15-Sept 30 MG<65'

Table 8. Canadian commercial samples available for pollock in divisions 4VW and in Division 4X and SA 5 by gear and season.

4VW

	OTB 4+				OTB TC, 1-3				GN				LL & Others			
Year	Jan-Apr	May-Aug	Sept-Dec	Total	Jan-Apr	May-Aug	Sept-Dec	Total	Jan-Apr	May-Aug	Sept-Dec	Total	Jan-Apr	May-Aug	Sept-Dec	Total
1970	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
1971	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1972	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1973	-	-	7	7	-	-	-	-	-	-	-	-	-	-	-	-
1974	2	-	1	3	-	-	-	-	-	-	-	-	-	-	-	-
1975	2	1	2	5	-	-	-	-	-	-	-	-	-	-	-	-
1976	1	1	5	7	-	-	-	-	-	-	-	-	-	-	-	-
1977	2	6	9	17	-	-	-	-	-	-	-	-	-	-	-	-
1978	8	5	1	14	-	-	-	-	-	-	-	-	-	3	-	3
1979	3	28	1	32	-	-	-	-	-	-	-	-	-	1	-	1
1980	9	3	10	22	-	-	-	-	-	-	-	-	-	1	-	1
1981	8	5	4	17	-	3	-	3	-	2	-	2	-	-	-	-
1982	7	7	4	18	-	-	-	-	-	1	1	2	-	-	-	-
1983	25	13	7	45	-	-	-	-	-	1	2	3	-	-	-	-
1984	12	15	15	42	1	-	3	4	-	2	-	2	-	3	-	3
1985	10	18	14	42	-	-	-	-	-	2	2	4	-	-	-	-
1986	22	20	12	54	-	1	1	2	-	1	1	2	-	2	1	3
1987	17	19	13	49	3	2	1	6	-	5	-	5	-	-	-	-

4X+5

	OTB 4+				OTB TC, 1-3				GN				LL & Others			
Year	Jan-Apr	May-Aug	Sept-Dec	Total	Jan-Apr	May-Aug	Sept-Dec	Total	Jan-Apr	May-Aug	Sept-Dec	Total	Jan-Apr	May-Aug	Sept-Dec	Total
1970	-	3	2	5	-	1	-	1	-	-	-	-	-	-	-	-
1971	-	4	1	5	-	4	-	4	-	-	-	-	-	-	-	-
1972	1	2	3	6	-	-	1	1	-	-	-	-	-	-	-	-
1973	3	4	4	11	-	1	1	2	-	-	-	-	-	-	-	-
1974	2	6	12	20	3	-	1	4	-	-	-	-	-	-	-	-
1975	3	10	5	18	3	4	-	7	-	-	1	1	-	-	-	-
1976	6	14	9	29	1	2	-	3	-	2	-	2	-	-	-	-
1977	27	6	4	37	1	-	3	4	-	1	-	1	-	-	-	-
1978	16	14	2	32	-	-	-	-	-	3	2	5	-	-	-	-
1979	5	5	1	11	-	2	-	2	-	2	-	2	-	1	-	1
1980	10	6	12	28	1	8	-	9	-	1	1	2	-	-	-	-
1981	4	2	2	8	11	8	5	24	1	3	1	5	1	-	-	1
1982	9	5	11	25	4	14	-	18	1	6	3	10	-	2	-	2
1983	18	12	1	31	9	22	6	37	1	5	3	9	-	5	1	6
1984	6	2	1	9	9	9	10	28	-	3	2	5	-	4	-	4
1985	2	3	2	7	13	9	4	26	2	10	5	17	-	2	-	2
1986	5	3	-	8	13	23	4	40	2	13	3	18	-	12	2	14
1987	4	14	6	24	14	27	1	42	-	18	5	23	3	7	-	10

Table 9. Grouping of catch by gears and time period for estimation of removals-at-age. OTB trawls are primarily stern bottom trawls, but there are some side trawls; GN are gillnets, LL are longlines, and others are primarily inshore fisheries.

Year	Period	Tonnage Class	Gears	No. of Samples	Area	Number Aged	Number Measured	Catch (t)	Weight-Length Relationship a	b	Cruise	
1970	April	TC 4+	OTB	1	4VW	55	966	1870	0.01427	2.93733	Cameron 175/176	July 1970
	Jan-Dec	TC 4+	OTB	5	4X+5	178	1348	4135	0.00937	3.07143	Cameron 175/176	July 1970
1971	no samples - 4VW											
	Jan-Dec	TC 4+	OTB	5	4X+5	170	889	6465	0.03004	2.74758	Cameron 188/189	July 1971
1972	no samples - 4VW											
	Jan-Dec	TC4 4+	OTB	6	4X+5	182	1101	11399	0.01871	2.89470	Cameron 201/202	July 1972
1973	Jan-Dec	TC 4+	OTB	7	4VW	276	1564	3155	0.018154	2.88880	Cameron 212/213	July 1973
	Jan-Dec	TC 4+	OTB	11	4X+5	416	2208	10725	0.014285	2.93835	Cameron 212/213	July 1973
1974	Jan-Dec	TC 4+	OTB	3	4VW	136	733	2426	0.01676	2.89081	Cameron 225/226	July 1974
	Jan-Dec	TC 4+	OTB	24	4X+5	762	5470	13371	0.02385	2.80718	Cameron 225/226	July 1974
1975	Jan-Dec	TC 1-6	GN, LL, Other	1	4VWX+5	32	224	6331	0.02286	2.83914	Cameron 236/237	July 1975
	Jan-Dec	TC 4+	OTB	5	4VW	188	1259	3891	0.01676	2.89081	Cameron 236/237	July 1975
	Jan-Dec	TC 4+	OTB	18	4X+5	716	4451	12102	0.02286	2.83914	Cameron 236/237	July 1975
1976	Jan-Dec	TC 1-6	GN, LL, Other	2	4VWX+5	63	445	7687	0.00588	3.13928	Cameron 250/251	July 1976
	Jan-Dec	TC 4+	OTB	7	4VW	306	1790	2230	0.00996	3.03793	Cameron 250/251	July 1976
	Jan-Dec	TC 4+	OTB	22	4X+5	803	5354	9041	0.00588	3.13928	Cameron 250/251	July 1976
1977	Jan-Dec	TC 1-6	GN, LL, Other	1	4VWX+5	30	256	4880	0.03096	2.76665	Cameron 265/266	July 1977
	Jan-Dec	TC 4+	OTB	16	4VW	736	4321	6794	0.01251	2.99009	Cameron 265/266	July 1977
	Jan-Dec	TC 4+	OTB	36	4X+5	1420	8182	9028	0.03046	2.76665	Cameron 265/266	July 1977
1978	Jan-Dec	TC 1-6	GN, LL, Other	10	4VWX+5	179	1821	6152	0.027	2.81326	Cameron 279/280	July 1978
	Jan-Dec	TC 4+	OTB	14	4VW	529	4786	5899	0.02081	2.86517	Cameron 279/280	July 1978
	Jan-Dec	TC 4+	OTB	31	4X+5	1019	8513	10446	0.0270	2.81326	Cameron 279/280	July 1978
1979	Jan-Dec	TC 1-6	GN, LL, Other	3	4VWX+5	137	938	7685	0.01350	2.95963	Cameron 292/293	July 1979
	Jan-Dec	TC 1-3	OTB	2	4VWX+5	56	387	6092	0.01350	2.95963	Cameron 292/293	July 1979
	Jan-Apr	TC 4+	OTB	3	4VW	99	853	1331	0.04196	2.67328	Hammond 13/14	March 1979
	May-Aug	TC 4+	OTB	28	4VW	875	8458	5008	0.01358	2.97418	Cameron 292/293	July 1979
	Sept-Dec	TC 4+	OTB	1	4VW	23	194	1710	0.00924	3.05383	Hammond 26/27	Oct 1979
	Jan-Apr	TC 4+	OTB	5	4X+5	161	1179	3414	0.0114	2.98252	Hammond 13/14	March 1979
	May-Aug	TC 4+	OTB	5	4X+5	174	1547	3246	0.01350	2.95963	Cameron 292/293	July 1979
	Sept-Dec	TC 4+	OTB	1	4X+5	37	266	982	0.00388	3.26457	Hammond 26/27	Oct 1979

Table 9. Continued.

Year	Period	Tonnage Class	Gears	No. of Samples	Area	Number Aged	Number Measured	Catch (t)	Weight-Length Relationship a	b	Cruise	
1980	Jan-Dec	TC 1-6	GN, LL, Other	3	4VWX+5	55	377	9351	0.04400	2.6941	Cameron 306/307	July 1980
	Jan-Dec	TC 1-3	OTB	9	4VWX+5	286	2135	6685	0.04400	2.6941	Cameron 306/307	July 1980
	Jan-Apr	TC 4+	OTB	9	4VW	282	2023	2315	0.01931	2.84627	Hammond 33/34	March 1980
	May-Aug	TC 4+	OTB	2	4VW	88	833	3849	0.03871	2.70659	Cameron 306/307	July 1980
	Sept-Dec	TC 4+	OTB	10	4VW	335	2462	3235	0.00864	3.08543	Hammond 42/43	Oct 1980
	Jan-Apr	TC 4+	OTB	10	4X+5	320	2650	4307	0.00782	3.06568	Hammond 33/34	March 1980
	May-Aug	TC 4+	OTB	6	4X+5	172	1418	3409	0.04400	2.69410	Cameron 306/307	July 1980
	Sept-Dec	TC 4+	OTB	12	4X+5	444	2541	2380	0.00820	3.09256	Hammond 42/43	Oct 1980
1981	Jan-Dec	TC 1-6	GN, LL, Other	8	4VWX+5	216	1810	9829	0.01246	2.98215	Hammond 64/65	Oct 1981
	Jan-Dec	TC 1-3	OTB	27	4VWX+5	901	6010	6268	0.01859	2.92225	Cameron 321/322	July 1981
	Jan-Apr	TC 4+	OTB	8	4VW	224	2099	3903	0.00581	3.12942	Hammond 48/49	March 1981
	May-Aug	TC 4+	OTB	5	4VW	143	1261	1342	0.03077	2.76718	Cameron 321/322	July 1981
	Sept-Dec	TC 4+	OTB	4	4VW	130	937	8417	0.00847	3.07881	Hammond 64/65	Oct 1981
	Jan-Apr	TC 4+	OTB	4	4X+5	244	1915	4223	0.00976	3.01206	Hammond 48/49	March 1981
	May-Aug	TC 4+	OTB	2	4X+5	64	532	558	0.01589	2.9225	Cameron 321/322	July 1981
	Sept-Dec	TC 4+	OTB	2	4X+5	66	488	4956	0.01246	2.98215	Hammond 64/65	Oct 1981
1982	Jan-Dec	TC 1-6	GN, LL, Other	14	4VWX+5	402	2605	10980	0.03023	2.76957	Hammond 80/81	July 1982
	Jan-Dec	TC 1-3	OTB	18	4VWX+5	659	4348	7720	0.03023	2.76957	Hammond 80/81	July 1982
	Jan-Apr	TC 4+	OTB	7	4VW	229	1686	2659	0.01446	2.91396	Hammond 71/72	March 182
	May-Aug	TC 4+	OTB	7	4VW	228	1623	3043	0.0377	2.75290	Hammond 80/81	July 1982
	Sept-Dec	TC 4+	OTB	4	4VW	146	912	4033	0.00469	3.22032	Needler 002/003	Oct 1982
	Jan-Apr	TC 4+	OTB	9	4X+5	293	2172	1628	0.01055	2.99328	Hammond 71/72	March 1982
	May-Aug	TC 4+	OTB	5	4X+5	203	1197	3645	0.03023	2.76957	Hammond 80/82	July 1982
	Sept-Dec	TC 4+	OTB	11	4X+5	396	2606	3665	0.00874	3.08571	Nedler 002/003	Oct 1983
1983	Jan-Dec	TC 1-6	Gn, LL, Other	18	4VWX+5	499	3487	8264	0.01149	2.98690	Needler 12/13	July 1983
	Jan-Dec	TC 1-3	OTB	37	4VWX+5	1236	9376	9492	0.01149	2.98690	Needler 12/13	July 1983
	Jan-Aug	TC 4+	OTB	38	4VW	1171	9812	7864	0.02903	2.76587	Needler 12/13	July 1983
	Sept-Dec	TC 4+	OTB	7	4VW	162	1994	1029	0.01134	3.00190	Needler 17/18	Oct 1983
	Jan-Aug	TC 4+	OTB	30	4X+5	1056	8310	5516	0.01149	2.98690	Needler 12/13	July 1983
	Sept-Dec	TC 4+	OTB	1	4X+5	43	356	396	0.01047	3.03012	Needler 17/18	Oct 1983
1984	Jan-Dec	TC 1-6	GN, LL, Other	14	4VWX+5	347	2862	7038	0.02339	2.8404	Needler 31/32	July 1984
	Jan-Dec	TC 1-3	OTB	32	4VWX+5	1119	8642	14184	0.02339	2.8404	Needler 31/32	July 1984
	Jan-Apr	TC 4+	OTB	12	4VW	346	3024	2080	0.01171	2.96209	Needler 24/25	March 1984
	May-Aug	TC 4+	OTB	15	4VW	345	3180	3091	0.02134	2.84581	Needler 31/32	July 1984
	Sept-Dec	TC 4+	OTB	15	4VW	431	3410	3550	0.01134	3.00190	Needler 17/18	Oct 1983

Table 9. Continued.

Year	Period	Tonnage Class	Gears	No. of Samples	Area	Number Aged	Number Measured	Catch (t)	Weight-Length Relationship a	b	Cruise	
1984	Jan-Apr	TC 4+	OTB	6	4X+5	203	1575	728	0.00984	3.00564	Needler 24/25	March 1984
	May-Aug	TC 4+	OTB	2	4X+5	75	624	1563	0.02339	2.84041	Needler 31/32	July 1984
	Sept-Dec	TC 4+	OTB	1	4X+5	23	218	564	0.01047	3.03012	Needler 17/18	Oct 1983
1985	Jan-Dec	TC 1-6	GN, LL, Other	23	4VWX+5	442	3845	11631	0.01654	2.90193	Needler 48/49	July 1985
	Jan-Dec	TC 1-3	OTB	26	4VWX+5	694	5902	15673	0.01654	2.90193	Needler 48/49	July 1985
	Jan-Apr	TC 4+	OTB	10	4VW	278	2313	3464	0.01171	2.96209	Needler 24/25	March 1984
	May-Aug	TC 4+	OTB	18	4VW	491	4199	3687	0.01920	2.85330	Needler 48/49	July 1985
	Sept-Dec	TC 4+	OTB	14	4VW	379	3137	4514	0.01134	3.00190	Needler 17/18	Oct 1983
	Jan-Apr	TC 4+	OTB	2	4X+5	72	541	580	0.00984	3.00564	Needler 24/25	March 1984
	May-Aug	TC 4+	OTB	3	4X+5	111	766	829	0.01654	2.90193	Needler 48/49	July 1985
	Sept-Dec	TC 4+	OTB	2	4X+5	70	395	876	0.01047	3.03012	Needler 17/18	Oct 1983
1986	Jan-Dec	TC 1-6	GN, LL, Other	37	4VWX+5	631	6357	14739	0.01611	2.91262	Needler 65/66	July 1986
	Jan Dec	TC 1-3	OTB	42	4VWX+5	1306	9481	10419	0.01611	2.91262	Needler 65/66	July 1986
	Jan-Apr	TC 4+	OTB	22	4VW	566	4679	4861	0.01762	2.86994	Needler 65/66	July 1986
	May-Aug	TC 4+	OTB	20	4VW	556	4697	6499	0.01762	2.86994	Needler 65/66	July 1986
	Sept-Dec	TC 4+	OTB	12	4VW	354	2860	3957	0.01762	2.86994	Needler 65/66	July 1986
	Jan-Apr	TC 4+	OTB	5	4X+5	137	1370	1326	0.01611	2.91262	Needler 65/66	July 1986
	May-Aug	TC 4+	OTB	3	4X+5	82	653	939	0.01611	2.91262	Needler 65/66	July 1986
	Sept-Dec	TC 4+	OTB	-	4X+5	-	-	235	0.01611	2.91262	Needler 65/66	July 1986
1987	Jan-Dec	TC 1-6	GN, LL, Other	38	4VWX+5	893	7252	14183	0.015	2.93000	Needler 85/86/87	July 1987
	Jan-Dec	TC 1-3	OTB	48	4VWX+5	1399	11642	9976	0.015	2.93000	Needler 85/86/87	July 1987
	Jan-Apr	TC 4+	OTB	17	4VW	441	3985	5609	0.0243	2.80360	Needler 85/86/87	July 1987
	May-Aug	TC 4+	OTB	19	4VW	418	4046	4178	0.0243	2.80360	Needler 85/86/87	July 1987
	Sept-Dec	TC 4+	OTB	13	4VW	331	2776	3998	0.0243	2.80360	Needler 85/86/87	July 1987
	Jan-Apr	TC 4+	OTB	4	4X+5	137	1067	2435	0.015	2.93000	Needler 85/86/87	July 1987
	May-Aug	TC 4+	OTB	14	4X+5	483	3789	2518	0.015	2.93000	Needler 85/86/87	July 1987
	Sept-Dec	TC 4+	OTB	6	4X+5	180	1399	2408	0.015	2.93000	Needler 85/86/87	July 1987

Table 10. Catch at age.

TOTAL CATCH AT AGE

	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87
1	0	0	0	0	0	0	0	0	0	8	0	0	0	1	1	0	0	0
2	567	1516	795	1168	261	260	234	56	115	296	361	699	247	94	64	248	50	77
3	389	1426	2170	2693	1591	1436	2190	1751	1548	4067	704	2754	4824	2732	1197	2403	1291	1443
4	1543	3352	1255	3131	3245	5297	3085	3779	3612	7487	3798	1309	2245	11166	5191	2873	6015	3133
5	1360	2301	1652	5279	3074	2566	7314	2443	3632	4475	6802	3615	847	1663	9793	5796	4453	2112
6	332	1576	974	737	1359	2300	1454	2630	1887	3134	4096	4720	2599	427	1251	8081	5234	4131
7	666	541	463	187	404	1041	1342	1049	2064	783	1605	2761	2631	970	206	1376	4510	3031
8	464	232	110	103	213	263	272	673	902	731	469	964	1349	694	374	211	494	2112
9	101	7	158	256	70	30	21	206	411	160	374	305	564	546	330	222	175	731
10	112	8	26	87	100	35	15	81	151	62	110	258	266	120	194	353	168	31
11	34	9	60	15	81	56	21	45	103	39	45	63	190	133	60	134	229	145
12	6	2	35	5	45	49	57	172	22	112	5	148	120	102	136	172	251	112

COMMERCIAL CATCH AT AGE

	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

LB CATCH AT AGE

	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table 11. Total percent catch at age and total percent biomass at age for pollock (1970 - 1987).

(A) TOTAL PERCENT CATCH AT AGE 25/ 8/88

	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	9	14	8	6	2	2	2	0	1	1	2	4	2	0	0	1	0	0
3	9	23	23	14	45	11	16	13	11	20	4	15	30	14	6	11	6	6
4	24	22	28	46	21	39	22	28	25	37	21	7	14	58	28	13	26	14
5	21	19	19	27	19	19	38	18	26	22	37	22	5	10	52	26	19	34
6	14	15	10	4	8	18	10	22	13	11	22	26	16	2	7	37	23	18
7	11	5	5	1	2	8	10	8	14	4	9	15	16	4	1	6	20	14
8	7	2	1	1	1	2	2	5	4	3	3	5	8	5	2	1	2	9
9	3	0	4	1	1	1	0	2	3	1	2	2	4	3	2	1	1	1
10	2	0	0	0	1	1	0	1	1	0	1	1	2	1	1	2	1	0
11	1	0	1	0	0	0	0	0	1	0	0	0	1	1	0	1	1	1
12	0	0	1	0	0	0	0	2	2	1	0	1	1	1	1	1	1	1

(B) TOTAL PERCENT BIOMASS AT AGE 25/ 8/88

	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	2	4	3	1	1	1	0	0	0	0	1	1	0	0	0	0	0	0
3	4	15	12	8	27	5	7	5	4	10	2	7	10	7	3	4	2	2
4	16	19	22	41	18	27	16	16	14	26	13	6	11	39	22	9	16	9
5	20	23	24	32	24	20	39	17	22	26	34	19	6	12	50	25	17	30
6	16	23	15	7	15	24	14	27	16	17	26	28	20	4	9	42	26	19
7	16	10	9	3	5	14	16	12	21	8	12	21	22	9	2	8	25	18
8	13	5	2	1	3	4	4	10	8	6	5	10	13	11	4	2	4	14
9	7	0	9	4	2	2	1	4	6	2	4	4	7	7	4	2	1	2
10	4	0	1	1	2	2	0	1	2	1	2	3	4	4	2	4	3	1
11	2	0	1	0	2	1	0	1	2	1	1	1	3	2	1	1	3	2
12	0	0	2	0	1	1	1	6	4	2	1	2	3	5	2	2	3	3

Table 12. Canadian percent catch at age and Canadian percent biomass at age for pollock (1970-1987).

Canadian Percent Catch at age

(A)	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87
2	10	16	8	7	2	2	2	0	0	1	1	1	1	0	0	0	0	0
3	9	24	23	14	44	10	14	15	8	19	2	11	31	13	6	4	2	3
4	23	22	28	46	21	39	21	30	31	39	15	6	13	63	28	15	20	15
5	20	18	20	26	19	20	38	18	31	24	43	18	5	8	56	28	25	32
6	13	14	10	4	9	18	11	23	13	12	26	34	16	2	5	42	25	23
7	11	5	5	1	3	8	11	8	12	4	9	21	19	3	1	7	23	15
8	8	2	1	1	1	2	2	4	3	2	2	6	9	6	2	1	2	11
9	3	0	4	1	1	1	0	1	1	0	1	2	3	3	2	1	1	1
10	2	0	0	0	1	1	0	0	0	0	0	1	1	1	1	2	1	0
11	1	0	1	0	1	0	0	0	0	0	0	0	1	0	0	1	1	0

Canadian Percent Biomass at age

(B)	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87
2	2	5	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0
3	4	16	12	8	27	4	6	7	4	10	1	6	12	7	3	2	1	1
4	15	19	22	41	18	27	14	18	20	29	10	4	11	46	24	10	14	10
5	19	23	24	32	24	22	39	18	29	29	39	15	5	11	55	26	21	26
6	16	23	15	7	15	24	15	31	18	18	29	33	20	3	7	45	28	33
7	16	10	9	3	6	14	19	13	19	7	12	25	26	5	1	9	28	20
8	14	5	2	2	3	4	4	9	6	4	4	10	14	13	4	1	3	15
9	8	0	11	4	2	1	1	3	4	1	3	4	6	7	4	2	1	2
10	5	0	1	1	2	1	0	1	0	0	1	3	3	3	2	3	2	2
11	2	0	1	0	2	1	1	1	1	0	0	1	2	1	0	1	3	1

Table 13. USA percent catch at age and USA percent biomass at age for pollock (1970-1987).

US Percent catch at age

(A)	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	1	5	9	1	2	3	1	1	2	4	3	2	2	1	1	3	1	1
3	9	16	25	17	47	12	19	8	16	24	7	23	27	17	8	26	11	16
4	28	26	28	48	21	41	25	25	12	31	32	10	16	43	28	10	37	12
5	26	24	18	31	18	16	38	19	14	18	25	29	7	14	44	24	11	41
6	16	19	10	4	7	16	8	22	14	9	16	12	18	4	10	26	19	8
7	10	6	5	2	2	7	6	9	20	4	9	6	9	8	2	4	14	10
8	5	3	1	1	1	2	1	7	8	5	2	4	7	4	2	1	2	8
9	3	0	1	1	0	1	0	3	6	2	3	2	4	3	2	1	1	1
10	1	0	0	1	0	1	0	2	3	1	1	2	2	2	2	2	2	1
11	0	0	1	0	0	1	0	1	2	0	1	1	2	2	1	1	1	1
12	0	0	1	0	0	1	0	5	5	2	1	2	5	4	2	2	2	2

US Percent Biomass at age

(B)	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	2	3	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0
3	4	13	14	8	30	6	10	3	5	10	3	10	7	2	3	6	4	6
4	21	18	24	40	19	30	20	13	6	22	20	9	11	25	19	6	22	13
5	22	22	24	36	25	17	40	15	11	20	24	31	7	14	43	24	10	30
6	18	22	16	7	13	22	12	23	14	13	19	16	23	3	12	34	24	20
7	14	11	10	4	5	12	11	13	25	9	13	10	13	12	3	7	22	14
8	8	6	2	1	4	5	2	10	11	11	6	8	13	7	5	2	4	11
9	6	0	2	2	1	2	0	5	10	5	3	3	8	9	4	3	2	3
10	2	0	1	2	1	2	0	3	6	2	3	3	6	6	3	3	2	2
11	1	0	1	0	1	2	0	1	4	1	2	1	5	4	2	2	3	2
12	0	0	2	0	1	2	1	12	2	2	4	2	11	12	6	2	3	2

Table 14. Mean weights at age.

TOTAL WEIGHT AT AGE 31/ 8/86

	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.00	0.00	0.00	0.63	0.36	0.00	0.10	0.00
2	0.56	0.78	1.06	0.50	0.82	0.86	0.60	0.83	0.54	0.73	0.95	0.62	0.60	0.73	1.03	0.70	0.80	0.72
3	1.38	1.70	1.86	1.27	1.40	1.28	1.23	1.13	1.23	1.19	1.39	1.47	1.13	1.16	1.47	1.04	1.19	1.13
4	2.19	2.12	2.77	1.95	1.95	1.99	1.91	1.60	1.80	1.64	1.95	2.46	2.55	1.67	2.15	1.93	1.85	1.94
5	3.05	3.16	4.28	2.65	3.01	3.06	2.77	2.60	2.68	2.72	2.79	2.95	3.51	3.06	2.63	2.75	2.59	2.57
6	3.78	4.00	5.29	3.96	4.09	3.85	3.69	3.53	3.95	3.53	3.51	3.43	4.15	4.16	3.51	3.23	3.40	3.94
7	4.77	4.99	5.95	4.86	5.06	5.09	4.61	4.56	4.63	4.65	4.21	4.38	4.51	4.88	5.15	3.74	3.84	3.88
8	5.82	6.24	6.32	6.23	6.12	6.52	5.55	5.67	5.79	5.66	5.65	5.83	5.28	5.17	5.75	5.15	4.84	4.29
9	7.08	7.25	8.83	6.81	6.66	7.52	7.00	6.81	6.59	6.75	6.48	6.74	6.37	6.01	5.98	6.35	6.26	5.19
10	7.10	8.62	7.60	7.42	7.36	7.53	7.72	7.06	6.77	7.47	7.72	7.44	7.34	6.72	6.51	6.32	6.83	7.16
11	9.09	9.00	6.81	8.24	8.52	8.31	8.54	8.80	7.53	8.18	7.87	7.70	7.79	7.71	7.52	6.64	6.70	7.39
12	8.11	9.00	9.56	8.66	9.33	9.74	9.23	9.06	7.93	8.31	8.84	8.23	8.27	8.86	8.54	8.61	7.95	8.42

CANADIAN WEIGHT AT AGE 31/ 8/86

	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.00	0.00	0.00	0.63	0.36	0.00	0.10	0.00
2	0.56	0.74	1.06	0.49	0.81	0.66	0.59	0.79	1.14	0.77	1.03	0.80	0.75	0.76	1.42	0.65	0.66	0.61
3	1.29	1.63	1.86	1.25	1.35	1.26	1.21	1.10	1.23	1.18	1.66	1.74	1.22	1.25	1.86	1.40	1.34	1.39
4	2.02	2.12	2.74	1.96	1.94	1.95	1.92	1.52	1.80	1.55	2.08	2.53	2.69	1.67	2.36	1.95	2.01	1.95
5	2.88	3.16	4.25	2.65	3.00	3.16	2.81	2.48	2.60	2.52	2.77	2.91	3.51	3.13	2.67	2.72	2.55	2.45
6	3.60	4.00	5.26	3.96	4.09	3.81	3.71	3.50	3.90	3.49	3.46	3.34	4.18	4.12	3.84	3.12	3.29	3.94
7	4.51	4.99	5.85	4.86	5.08	5.06	4.67	4.52	4.59	4.34	4.12	4.32	4.45	4.83	5.40	3.42	3.61	3.71
8	5.74	6.24	6.52	6.42	6.16	6.52	5.64	5.47	6.02	5.35	5.58	5.92	5.19	5.07	5.96	4.39	4.16	4.04
9	7.00	7.25	8.71	6.84	6.69	7.49	7.02	6.62	6.71	6.61	6.50	6.92	6.19	5.83	5.90	6.10	5.66	4.85
10	7.15	8.62	7.60	7.46	7.39	7.49	7.80	7.35	7.37	7.14	8.07	7.77	7.63	6.49	6.32	5.86	6.05	6.29
11	9.02	9.00	6.81	7.76	8.58	8.21	8.76	10.02	8.38	8.79	8.40	7.54	8.00	7.98	7.66	6.18	6.11	6.22
12	8.11	9.00	9.56	8.42	10.04	9.59	9.11	11.30	10.33	9.00	11.64	9.22	8.64	8.72	8.64	7.54	6.82	7.53

US WEIGHT AT AGE 31/ 8/86

	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.97	1.07	1.06	0.65	0.85	0.86	0.63	0.91	0.77	0.71	0.68	0.65	0.39	0.67	0.83	0.71	0.61	0.72
3	1.84	2.32	1.86	1.37	1.44	1.34	1.27	1.31	1.23	1.22	1.19	1.22	0.87	0.94	1.15	0.95	1.17	1.14
4	2.93	2.12	2.93	1.86	2.00	2.09	1.89	1.85	1.77	1.93	1.82	2.45	2.23	1.67	1.78	1.84	1.82	1.81
5	3.79	3.15	4.44	2.63	3.04	3.08	2.67	2.92	3.07	3.02	2.65	2.99	3.49	2.75	2.55	2.80	2.65	2.71
6	4.57	4.00	5.29	3.96	4.08	4.01	3.82	3.61	4.06	3.57	3.55	3.86	4.02	4.21	3.50	3.60	3.56	3.82
7	5.78	5.00	5.85	4.84	4.96	5.21	4.33	4.65	4.67	5.32	4.33	4.79	4.68	4.95	4.55	4.35	4.55	4.87
8	6.41	6.24	6.51	6.02	6.00	6.59	5.46	5.98	5.83	5.75	5.76	5.59	5.56	5.06	5.48	6.36	6.00	5.88
9	7.59	7.25	8.84	6.47	6.57	7.61	6.66	7.02	6.41	6.80	6.45	6.35	6.45	6.50	6.11	6.1	6.11	6.37
10	7.76	8.62	7.60	7.32	7.34	7.60	8.70	7.00	6.69	7.57	7.17	7.05	6.81	7.03	6.68	7.16	7.34	7.51
11	9.29	9.00	6.81	8.32	7.84	8.37	7.24	7.25	7.40	7.64	7.24	7.84	7.62	7.54	7.46	6.36	7.67	7.75
12	[illegible]	[illegible]	9.22	8.62	9.24	8.39	8.39	5.13	9.73	8.31	8.77	8.35	8.22	8.32	8.32	8.23	8.10	8.57

Table 15. Stratified mean weight-at-age in Canadian summer trawl surveys (strata 40 - 95).

	Year																		
Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
0	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.08	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.02	0.16	0.00	0.13	0.36	0.19	0.19	0.00	0.22
2	0.58	0.47	0.61	0.47	0.51	0.29	0.56	0.68	0.83	0.00	0.76	0.66	0.60	0.45	0.56	0.41	0.47	0.34	0.60
3	1.17	0.92	0.82	1.27	1.04	1.16	1.53	1.19	0.96	1.26	1.25	1.78	0.83	1.26	1.55	1.00	1.17	0.74	0.96
4	2.53	2.19	2.27	2.24	1.54	1.81	2.34	2.12	2.20	2.15	1.89	2.42	2.47	1.56	2.50	1.74	1.88	1.52	1.89
5	3.51	3.12	3.56	2.91	3.07	3.12	3.11	2.90	3.02	3.10	2.25	3.11	3.07	3.22	3.09	2.53	2.80	2.13	2.90
6	4.78	4.21	5.13	4.38	4.52	3.87	3.99	3.58	4.40	4.13	3.00	3.86	4.37	3.87	4.57	3.28	3.76	2.92	3.44
7	6.23	4.95	5.83	5.38	5.43	5.39	5.07	4.80	4.91	5.25	3.71	4.56	4.77	4.48	5.20	3.76	4.13	3.79	3.94
8	7.24	6.04	6.26	6.24	6.12	6.70	5.64	5.72	6.69	6.69	6.29	5.42	5.90	4.73	5.74	4.82	4.83	4.06	4.65
9	8.18	6.64	7.05	6.46	7.07	8.06	7.03	7.06	7.46	6.90	6.88	6.92	7.03	5.30	6.20	5.89	6.13	5.80	4.96
10	0.00	5.96	6.74	9.79	7.90	9.18	8.66	7.88	6.29	7.92	6.97	8.42	6.78	6.77	6.79	5.50	6.38	6.42	6.85
11	9.34	0.00	7.95	8.93	8.76	10.04	8.33	7.85	0.00	0.00	0.00	7.64	8.03	7.35	7.68	7.11	6.08	5.63	7.24
12	8.84	0.00	8.76	12.70	10.19	0.00	7.50	8.57	8.93	0.00	0.00	0.00	7.82	7.64	7.97	7.47	6.29	6.91	6.44
13	0.00	0.00	7.82	0.00	0.00	0.00	9.23	0.00	9.81	0.00	0.00	6.91	8.77	0.00	9.21	7.91	6.47	7.25	9.07
14	0.00	0.00	0.00	0.00	0.00	0.00	11.21	0.00	11.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.41	8.85	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.90	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.85	0.00	10.69	10.12

Table 16. Regression coefficients.

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
YEAR 1	75	INTERCEPT	-0.477	0.088	1149
MONTH 2	7				
TONNAGE CLASS 4	5				
DIVISION 5	3				
YEAR 1	74	1	0.051	0.093	74
	76	2	-0.157	0.095	67
	77	3	0.199	0.092	78
	78	4	0.382	0.094	74
	79	5	0.518	0.090	88
	80	6	0.344	0.090	89
	81	7	0.350	0.089	93
	82	8	0.331	0.089	91
	83	9	0.357	0.089	93
	84	10	0.625	0.090	96
	85	11	0.501	0.094	77
	86	12	0.528	0.095	75
	87	13	0.381	0.093	84
MONTH 2	1	14	0.228	0.091	56
	2	15	0.177	0.081	78
	3	16	0.169	0.076	95
	4	17	0.086	0.078	86
	5	18	-0.023	0.073	107
	6	19	-0.046	0.068	142
	8	20	-0.116	0.073	106
	9	21	-0.125	0.073	105
	10	22	-0.160	0.074	98
	11	23	0.083	0.081	77
	12	24	0.336	0.084	68
TONNAGE CLASS 4	2	25	-0.898	0.056	171
	3	26	-0.429	0.049	255
	4	27	-0.491	0.044	270
DIVISION 5	1	28	0.072	0.056	165
	2	29	0.080	0.044	286
	4	30	-0.006	0.069	86
	5	31	0.053	0.056	137

Legend:

Category	Code
5-Division	1-4V
	2-4W
	4-5Y
	5-5Z

Table 17. Commercial catch rates (t/hr) for pollock (main species) in Divisions 4VWX and Subarea 5.

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Canadian OTB-2 (TC5) CPUE (t/hr)																		
June-August	.74	.78	.81	1.07	.58	.61	.52	.69	.84	1.16	.97	.89	1.58	.87	1.28	.70	1.38	.845
April-November	.86	.64	.75	.75	.66	.70	.57	.78	.89	1.09	.94	1.01	1.32	1.05	1.33	.96	1.26	.94

Table 18. International Observer Program (IOP) catch rates (t/hr) for pollock (main species) in Divisions 4VWX and Subarea 5.

	1982	1983	1984	1985	1986	1987
Canadian OTB-2 (TC5) CPUE (t/hr)						
April-November	1.95	1.42	2.05	2.37	1.75	1.06

Table 19. Stratified total numbers-at-age (x 10^{-3}) in Canadian summer trawl surveys (strata 40 - 95).

	Year																		
Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	30	0	0	0	30	0	0	0	0	0	49	29	0	426	148	30	186	0	86
2	7613	3106	82	1649	165	37	122	1108	29	0	4842	673	832	504	1989	6281	2571	2503	122
3	1866	2573	55	2021	3381	77	928	3266	610	458	5299	744	11816	3882	966	19321	2769	10352	2360
4	1132	713	618	9100	842	1375	2826	4177	2526	2631	14011	215	1129	7214	2965	14886	4065	15574	4622
5	825	165	1361	3442	1098	1182	5251	8604	3927	3305	22026	2147	502	830	8508	14291	4249	24663	9081
6	748	76	595	363	514	1587	1315	5998	1458	2401	5572	2143	1556	203	1297	11399	5807	9678	8090
7	502	115	157	220	548	252	2264	779	1365	986	3032	1492	1070	383	892	1693	4237	7021	7605
8	275	46	288	206	308	389	836	1308	424	710	872	1028	628	1113	1934	471	297	5715	4209
9	106	31	209	252	233	151	182	458	198	44	327	461	553	703	2919	854	45	220	2442
10	0	74	100	10	151	35	188	219	91	154	173	321	306	239	1811	1323	430	481	169
11	148	0	52	75	313	40	62	129	0	0	0	121	50	250	301	463	571	372	178
12+	28	0	111	48	131	0	203	49	98	0	0	54	208	86	662	428	365	1464	674
UK	0	0	17	59	0	0	45	15	71	97	122	195	143	116	186	15	31	119	0
TOTAL	13302	6899	3645	17444	7713	5125	14224	26110	10797	10824	56326	9621	18794	15949	24577	71455	25622	78164	39638
4+	3765	1220	3491	13715	4137	5010	13128	21721	10087	10232	46013	7981	6004	11021	21289	45808	20066	65189	37069
5+	2633	507	2873	4615	3295	3636	10302	17543	7561	7601	32002	7766	4874	3806	18324	30922	16001	49615	32447
6+	1808	342	1511	1174	2198	2454	5050	8940	3634	4295	9976	5619	4373	2976	9815	16631	11753	24952	23366

Table 20. Mean numbers/tow for 4VWX + 5 Pollock in Canadian summer bottom trawl surveys [1]

YEAR

Stratum	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	All	Divn
40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.41	45.11	0.34	2.43	
41	0.00	3.94	0.00	0.00	0.00	0.00	0.00	0.00	0.31	0.00	0.00	1.46	0.65	1.30	0.29	1.03	0.21	37.43	9.14	2.93	4Vn
42	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.00	0.16	0.33	0.06	
43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.18	0.00	0.00	0.00	0.00	0.00	0.02	
44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.83	0.34	0.00	0.08	
45	0.00	0.00	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.03	0.17	5.85	0.00	1.28	
46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.00	0.00	0.00	0.00	0.97	16.47	0.00	3.09	0.69	0.00	0.97	1.19	
47	0.00	0.00	0.00	0.37	0.00	0.44	0.00	0.00	0.00	0.61	0.00	0.00	0.51	0.26	0.00	0.00	0.00	0.00	0.00	0.12	4Vs
48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.08	0.00	0.00	0.00	0.00	5.35	0.00	0.52	0.00	0.00	0.55	
50	0.00	0.00	0.00	0.00	0.00	0.36	0.00	0.00	0.00	1.56	0.00	15.10	1.09	0.00	0.00	0.00	0.34	0.34	0.00	0.99	
51	0.00	0.00	0.00	0.00	0.00	0.00	0.55	0.49	3.13	25.93	0.00	2.92	571.50	0.00	0.00	96.76	0.73	133.02	22.13	45.11	
52	0.00	1.14	0.46	0.00	0.00	0.00	0.00	0.55	0.49	3.60	0.00	0.00	5.05	3.60	113.75	6.69	60.03	0.34	0.55	10.33	
53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.00	0.58	0.07	
54	0.00	0.00	0.34	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00	0.00	0.00	0.00	0.00	1.05	0.00	0.00	0.00	0.09	
55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.29	1.42	0.26	0.00	0.00	0.13	0.12	0.00	0.12	
56	0.39	0.27	0.00	0.18	0.00	0.00	0.00	0.34	0.00	0.00	0.00	0.00	0.00	0.16	2.97	1.94	0.17	0.70	4.73	0.62	
57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.03	
58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.27	0.00	0.00	0.44	0.00	1.03	0.20	
59	0.76	0.44	0.00	0.58	0.00	0.00	0.20	0.63	0.24	0.00	0.00	0.00	0.00	0.58	17.06	2.34	10.47	3.28	9.43	2.42	4W
60	75.99	0.00	0.83	4.12	0.00	5.07	0.00	0.97	14.72	1.45	353.50	0.97	6.55	29.17	36.66	12.40	8.92	337.21	7.87	47.18	
61	0.00	0.00	0.00	0.51	0.00	20.26	0.00	2.78	0.00	0.00	0.00	0.00	2.76	1.46	1.61	5.06	3.78	11.67	3.28	2.80	
62	0.00	0.65	0.00	0.00	5.10	2.73	0.23	0.00	3.82	1.22	55.19	6.87	0.78	0.00	1.29	48.10	14.78	3.98	5.48	7.91	
63	0.00	0.00	0.00	0.00	0.00	3.31	6.13	1.17	0.00	3.69	0.51	5.41	0.23	4.86	0.00	1.46	1.72	4.46	0.55	1.77	
64	0.00	0.00	0.19	0.00	0.00	0.00	0.32	1.79	3.52	0.97	0.00	0.00	0.00	41.22	0.62	2.96	0.28	4.57	1.58	3.05	
65	0.19	14.00	0.00	0.00	20.85	1.17	2.33	1.95	0.41	0.21	0.00	0.85	0.15	0.51	1.29	2.72	0.19	5.65	1.67	2.85	
66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.24	0.39	0.55	0.00	0.22	
70	2.19	3.46	0.38	27.47	2.43	0.49	96.62	18.47	74.79	9.30	1.09	16.40	0.00	42.41	6.56	60.82	19.56	72.06	74.27	27.83	
71	0.00	0.00	0.00	0.55	0.00	0.00	0.00	6.35	3.04	0.00	4.86	1.37	0.00	0.97	1.63	27.79	4.63	108.57	6.85	8.77	
72	2.06	22.75	0.82	1.09	2.57	0.00	2.13	1.74	0.46	0.34	16.42	5.83	0.49	5.47	1.75	377.22	6.18	3.60	8.51	24.18	
73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.55	0.00	0.00	0.38	0.00	0.00	0.00	0.00	0.49	2.13	0.51	0.00	0.21	
74	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.00	0.00	0.00	0.00	0.00	1.88	0.55	0.00	0.16	
75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.51	0.00	1.03	0.00	0.00	0.08	
76	1.09	0.49	0.00	9.24	5.72	7.70	2.19	20.79	1.75	0.00	1.17	0.00	0.00	4.03	50.95	0.00	26.74	1.35	35.97	9.01	
77	0.00	0.00	0.44	1.84	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	0.00	1.03	0.00	0.00	0.00	23.50	0.00	1.44	
78	1.46	2.43	0.88	0.97	0.00	1.09	0.00	0.00	1.75	1.29	0.00	0.00	0.00	0.00	0.00	3.89	0.36	0.00	4.12	0.96	
80	0.49	0.52	0.19	0.31	0.00	0.00	0.23	34.81	0.55	0.00	0.97	0.18	0.51	1.46	0.00	1.84	2.60	11.74	0.22	2.98	
81	0.00	2.92	0.00	6.00	1.30	0.00	0.29	0.00	2.11	0.00	1.82	1.46	1.80	2.73	0.26	0.46	8.14	0.51	2.36	1.69	4X
82	0.49	0.46	0.46	0.00	0.00	0.00	0.32	0.73	1.07	13.64	1.35	4.04	1.41	1.00	0.88	0.49	1.03	4.25	3.42	1.85	
83	0.00	0.00	2.43	0.00	0.00	0.00	1.95	0.49	0.00	0.58	0.78	0.00	0.52	0.51	1.54	0.49	0.00	1.44	1.03	0.63	
84	0.00	0.55	1.25	1.78	1.34	1.58	21.52	2.38	0.49	9.82	0.25	16.54	0.26	0.00	3.43	3.56	2.40	4.72	11.75	4.40	
85	23.72	0.00	7.00	83.38	2.17	0.00	1.99	127.10	1.59	19.79	21.61	3.57	58.78	1.70	23.70	13.35	46.03	14.24	127.16	30.36	
90	9.85	0.00	0.00	0.34	3.98	1.19	8.17	0.78	8.61	3.28	1.33	15.75	2.60	8.20	0.00	67.91	2.94	0.23	1.98	7.22	
91	0.00	0.38	25.14	5.10	1.13	0.65	2.52	1.53	0.00	46.01	1.92	0.53	0.60	1.88	3.09	4.55	26.08	64.80	3.65	9.98	
92	0.32	0.00	4.37	1.63	3.19	2.02	2.10	3.68	2.27	0.00	0.00	0.29	11.08	1.03	0.36	0.65	6.32	3.47	5.93	2.56	
93	0.00	0.00	0.00	1.54	0.00	0.46	0.58	1.16	0.00	0.69	1.32	0.00	4.25	1.94	0.00	46.94	0.65	4.12	0.00	3.54	
94	0.00	0.00	0.00	0.00	0.42	0.46	2.17	0.00	0.00	1.03	0.51	0.00	0.00	0.00	0.55	0.49	0.00	0.00	0.00	0.30	
95	0.00	0.00	2.02	0.15	1.54	0.70	0.00	0.00	0.00	1.06	1.21	2.92	0.00	0.67	0.00	0.92	0.00	0.00	0.00	0.59	

[1] Survey vessels: 1970 - 1981 A. T. Cameron
1982 Lady Hammond
1983 - 1988 Alfred Needler

Table 21. Stratified mean weights-per-standard-tow in Canadian summer trawl surveys (strata 40 - 95).

	Year																		
Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	0.001	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.013	0.012	0.001	0.009	0.000	0.004
2	1.054	0.343	0.012	0.181	0.020	0.003	0.016	0.178	0.006	0.000	0.873	0.105	0.117	0.053	0.261	0.613	0.288	0.198	0.017
3	0.520	0.558	0.011	0.604	0.828	0.021	0.335	0.916	0.141	0.136	1.568	0.312	2.311	1.157	0.353	4.571	0.764	1.797	0.536
4	0.683	0.368	0.330	4.805	0.307	0.587	1.560	2.092	1.337	1.332	6.232	0.123	0.658	2.658	1.746	6.103	1.804	5.569	2.062
5	0.691	0.122	1.143	2.364	0.794	0.870	3.848	5.892	2.847	2.413	11.693	1.577	0.363	0.631	6.193	8.517	2.806	12.415	6.205
6	0.853	0.075	0.720	0.376	0.547	1.449	1.238	5.062	1.544	2.339	3.939	1.950	1.606	0.185	1.398	8.826	5.156	6.661	6.556
7	0.747	0.134	0.215	0.278	0.701	0.320	2.710	0.882	1.613	1.219	2.655	1.604	1.205	0.404	1.094	1.503	4.126	6.282	7.072
8	0.475	0.066	0.426	0.303	0.444	0.615	1.111	1.765	0.681	1.121	1.294	1.314	0.875	1.241	2.620	0.535	0.339	5.478	4.616
9	0.207	0.048	0.347	0.385	0.389	0.287	0.303	0.762	0.356	0.072	0.530	0.753	0.917	0.879	4.271	1.187	0.065	0.301	2.854
10	0.000	0.104	0.160	0.022	0.281	0.075	0.385	0.407	0.138	0.288	0.284	0.637	0.490	0.382	2.901	1.715	0.646	0.729	0.272
11	0.330	0.000	0.097	0.158	0.648	0.094	0.121	0.238	0.000	0.000	0.000	0.218	0.094	0.433	0.545	0.777	0.819	0.494	0.305
12+	0.059	0.000	0.210	0.144	0.314	0.000	0.434	0.099	0.225	0.000	0.000	0.088	0.401	0.163	1.324	0.776	0.574	2.587	1.281
UK	0.000	0.000	0.005	0.085	0.000	0.000	0.109	0.033	0.160	0.235	0.275	0.496	0.344	0.246	0.472	0.027	0.065	0.242	0.000
TOTAL	5.619	1.818	3.676	9.705	5.274	4.320	12.169	18.326	9.047	9.155	29.342	9.177	9.381	8.444	23.187	35.152	17.460	42.753	31.780
4+	4.043	0.917	3.649	8.835	4.425	4.297	11.708	17.199	8.741	8.784	26.626	8.263	6.609	6.976	22.090	29.939	16.335	40.516	31.223
5+	3.360	0.550	3.318	4.030	4.119	3.709	10.149	15.106	7.404	7.452	20.394	8.140	5.951	4.318	20.344	23.837	14.531	34.947	29.161
6+	2.669	0.428	2.175	1.666	3.325	2.840	6.301	9.214	4.557	5.039	8.701	6.563	5.587	3.687	14.151	15.320	11.725	22.533	22.955

Table 22. Stratified mean catch-per-tow in weight (kg) and numbers for Scotian Shelf, Gulf of Maine, and Georges Bank pollock in NEFC[1] offshore spring, summer, and autumn bottom trawl surveys, 1963-1983[2].

Year	SPRING (Str. 13-40) Weight	SPRING (Str. 13-40) Numbers	AUTUMN (Str. 13-40) Weight	AUTUMN (Str. 13-40) Numbers
1963	-	-	5.79	1.46
1964	-	-	4.40	1.64
1965	-	-	2.74	0.83
1966	-	-	2.35	0.97
1967	-	-	1.80	0.52
1968	4.47	1.09	3.17	0.69
1969	2.66	1.12	6.58	1.31
1970	4.91	1.67	2.59	0.64
1971	4.39	1.18	3.96	1.09
1972	5.67	4.43	4.37	1.41
1973	4.82	4.00	4.71	1.64
1974	4.10	1.39	3.17	0.90
1975	5.90	1.67	2.04	0.70
1976	6.84	1.59	16.66	3.69
1977	3.44	1.63	8.78	2.14
1978	6.56	2.48	5.83	0.98
1979	4.75	1.06	5.81	1.28
1980	4.40	1.52	4.63	0.83
1981	6.30	2.00	7.75	5.24
1982	6.62	3.98	3.14	1.40
1983	1.83	0.92	3.03	0.98
1984	2.87	1.00	0.99	0.41
1985	8.36	2.81	2.43	1.12
1986	7.69	1.84	1.83	0.88
1987	13.67	6.94	2.04	0.60
1988	1.98	0.89	-	-

1 - NEFC = Northeastern Fisheries Centre

2 - The "36 Yankee" trawl was used from 1968-1972, and the "41 Yankee" trawl was used from 1973-1983. No gear conversion factors are available to adjust for differences in fishing power.

Table 23. USA Research Survey catch rates at age (Nos. per standard tow), 1970-1987. Autumn 1986 and 1987 age composition not available. (Strata 13-40).

		Age													Totals				
	Year	0	1	2	3	4	5	6	7	8	9	10	11	12+	1+	2+	3+	4+	5+
Spring	1970	0.01	0.52	0.05	0.17	0.20	0.05	0.07	0.09	0.12	0.08	0.04	0.04	0.23	1.86	1.14	1.09	0.92	0.72
	1971	0.10	0.15	0.13	0.13	0.09	0.07	0.08	0.04	0.09	0.06	0.07	0.07	0.20	1.18	1.03	0.90	0.77	0.68
	1972	-	1.20	1.49	0.90	0.20	0.05	0.05	0.07	0.12	0.04	0.07	0.04	0.17	4.40	3.20	1.71	0.81	0.61
	1973	-	0.01	2.80	0.51	0.15	0.14	0.04	0.03	0.10	0.04	0.09	0.02	0.09	4.02	4.01	1.21	0.70	0.55
	1974	-	0.01	0.10	0.53	0.14	0.08	0.16	0.07	0.03	0.00	0.01	0.10	0.16	1.39	1.38	1.28	0.75	0.61
	1975	-	0.01	0.33	0.20	0.34	0.08	0.09	0.10	0.08	0.05	0.06	0.02	0.29	1.65	1.64	1.31	1.11	0.77
	1976	-	0.08	0.11	0.14	0.15	0.24	0.13	0.15	0.17	0.11	0.03	0.04	0.24	1.59	1.51	1.40	1.26	1.11
	1977	-	0.14	0.38	0.23	0.06	0.16	0.32	0.13	0.11	0.02	0.02	0.01	0.04	1.62	1.48	1.10	0.87	0.81
	1978	-	0.00	0.22	0.42	0.65	0.63	0.15	0.11	0.08	0.07	0.05	0.04	0.07	2.49	2.49	2.27	1.85	1.20
	1979	-	0.10	0.05	0.07	0.08	0.15	0.14	0.08	0.16	0.08	0.03	0.03	0.08	1.05	0.95	0.90	0.83	0.75
	1980	-	0.15	0.15	0.09	0.28	0.25	0.20	0.23	0.08	0.04	0.02	0.00	0.05	1.54	1.39	1.24	1.15	0.87
	1981	-	0.01	0.72	0.13	0.12	0.18	0.26	0.08	0.07	0.05	0.09	0.06	0.20	2.02	1.96	1.24	1.11	1.00
	1982	-	0.13	1.63	0.84	0.55	0.11	0.33	0.11	0.14	0.05	0.01	0.02	0.07	3.99	3.86	2.23	1.39	0.84
	1983	-	0.57	0.06	0.02	0.02	0.01	0.00	0.06	0.04	0.01	0.02	0.02	0.10	0.92	0.35	0.29	0.27	0.25
	1984	-	0.15	0.15	0.09	0.10	0.14	0.07	0.04	0.04	0.05	0.03	0.04	0.07	1.00	0.85	0.70	0.61	0.51
	1985	-	0.26	0.19	0.30	0.22	0.59	0.78	0.19	0.01	0.08	0.06	0.05	0.09	2.81	2.56	2.37	2.07	1.84
	1986	-	0.11	0.14	0.07	0.17	0.17	0.38	0.37	0.09	0.05	0.04	0.08	0.17	1.84	1.73	1.59	1.52	1.35
	1987	-	0.13	0.86	2.59	2.46	0.40	0.20	0.09	0.10	0.03	0.00	0.02	0.04	6.94	6.79	5.93	3.34	0.88
Autumn	1970	0.01	0.13	0.08	0.01	0.09	0.08	0.08	0.04	0.02	0.01	0.02	0.01	0.07	0.64	0.51	0.43	0.42	0.33
	1971	0.02	0.11	0.38	0.16	0.02	0.06	0.09	0.04	0.08	0.03	0.01	0.01	0.09	1.08	0.97	0.59	0.43	0.41
	1972	0.00	0.38	0.27	0.20	0.08	0.07	0.08	0.07	0.05	0.04	0.03	0.03	0.10	1.40	1.02	0.75	0.55	0.47
	1973	0.00	0.03	0.71	0.12	0.17	0.11	0.11	0.09	0.07	0.00	0.12	0.02	0.10	1.65	1.62	0.91	0.79	0.62
	1974	0.00	0.00	0.08	0.28	0.20	0.11	0.08	0.09	0.01	0.02	0.00	0.02	0.02	0.91	0.91	0.63	0.55	0.35
	1975	0.01	0.22	0.06	0.03	0.11	0.07	0.04	0.09	0.01	0.01	0.01	0.01	0.03	0.68	0.47	0.41	0.38	0.26
	1976	0.00	0.03	0.03	0.15	0.55	1.63	0.50	0.31	0.14	0.05	0.01	0.01	0.29	3.70	3.67	3.64	3.49	2.94
	1977	0.00	0.06	0.17	0.24	0.29	0.42	0.38	0.22	0.11	0.09	0.02	0.00	0.14	2.14	2.08	1.91	1.67	1.38
	1978	0.00	0.03	0.19	0.04	0.04	0.09	0.09	0.15	0.08	0.06	0.04	0.03	0.12	0.96	0.93	0.74	0.70	0.66
	1979	0.00	0.01	0.02	0.26	0.33	0.19	0.13	0.08	0.09	0.05	0.04	0.01	0.06	1.27	1.26	1.24	0.98	0.65
	1980	0.01	0.13	0.01	0.01	0.05	0.11	0.06	0.07	0.13	0.08	0.06	0.04	0.07	0.82	0.69	0.68	0.67	0.62
	1981	0.00	0.07	3.59	0.98	0.14	0.20	0.13	0.04	0.00	0.00	0.01	0.00	0.08	5.24	5.17	1.58	0.60	0.46
	1982	0.01	0.07	0.44	0.40	0.29	0.01	0.05	0.04	0.02	0.02	0.00	0.02	0.04	1.40	1.33	0.89	0.49	0.20
	1983	0.00	0.49	0.03	0.05	0.04	0.07	0.01	0.06	0.08	0.03	0.02	0.02	0.06	0.98	0.49	0.46	0.41	0.37
	1984	0.00	0.12	0.18	0.02	0.01	0.01	0.03	0.00	0.00	0.02	0.02	0.02	0.02	0.45	0.33	0.15	0.13	0.12
	1985	0.00	0.62	0.05	0.08	0.07	0.12	0.07	0.01	0.00	0.00	0.03	0.01	0.04	1.10	0.48	0.43	0.35	0.28

Table 24. Stratified mean catch-per-tow in numbers and weight (kg) for pollock in the Massachusetts inshore spring surveys[1], 1978-1987.

Year	Stratified Mean Catch-Per-Tow in Numbers					Stratified Mean Catch-Per-Tow in Weight (kg)
	AGE					
	0	1	2	3+	Total	
Massachusetts (Spring)						
1978	2.07	0.01	0.13	0.06	2.27	0.11
1979	4.34	0.04	0.01	0.06	4.45	0.07
1980	0.30	8.37	0.20	0.02	8.89	0.72
1981	1.52	1.42	1.40	0.00	4.34	0.54
1982	1.79	0.00	0.06	0.00	1.85	0.03
1983	0.03	6.45	0.27	0.04	6.79	0.68
1984	0.04	0.00	0.02	0.00	0.06	0.01
1985	0.88	0.02	0.03	0.00	0.93	0.04
1986	0.22	0.01	0.00	0.00	0.23	0.003
1987	0.23	0.04	-	-	0.27	0.017

[1] Regions 1-5 (STRATA 11-21 and 25-36).

Table 25. ADAPT summary for Divisions 4VWX + Subarea 5 pollock.

Parameters

Year-class estimates

N_i 1988 $i = 7$ to 8

Calibration constants for July RV numbers

K_i $i = 6$ to 8

Calibration constant for C/E vs exploitable biomass

K'

Age aggregated for ages 2 to 11, exploitable biomass calculated with annual PR based on fully recruited F based on ages 7 and 8.

Structure Imposed

- natural mortality equal to 0.2
- error in catch-at-age assumed negligible
- no intercepts
- partial recruitment in 1987 fixed for age 2-6 calculated as the mean 1979-86 assuming flat topped recruitment for ages 7 and older
- F for older age groups calculated as a weighted F for ages 6, 7, and 8

Input

- $C_{i,t}$ $i = 2$ to 11 $t = 1974$-1987
- C/E_t $t = 1974$ to 1987
- $RV_{i,t}$ $i = 6$ to 8 $t = 1974$ to 1987

Objective Function

- log transformation

$$\Sigma_i \Sigma_t \text{ (obs (Ln } RV_{it}) - \text{pred (Ln } RV_{it}))^2 +$$

$$\Sigma_t \text{ (obs (Ln } C/E_t) - \text{pred (Ln } C/E_t))^2$$

Summary

- number of observations = 54
- number of parameters = 6

Table 26. Final parameter estimates and significant statistics for age 6-8 numbers and age aggregated numbers and corresponding slopes from ADAPT.

Approximate Statistics Assuming Linearity Near Solution

Orthogonality Offset	0.002999
Mean Square Residuals	0.263767

Parameters	Age	Par. Est	STD. ERR	T. Statistic
Population	7	7.46876E0003	3.25203E0003	2.29664E0000
Population	8	4.47863E0003	1.95628E0003	2.28936E0000
Slope	6	3.15130E0002	4.73390E0001	6.65688E0000
Slope	7	3.98326E0002	6.00089E0001	6.63778E0000
Slope	8	5.55047E0002	8.48675E0001	6.54015E0000
Age Agg.		1.38084E0001	2.16202E0000	6.38678E0000

Correlations between estimated parameters for divisions 4VWX + Subarea 5 pollock.

1	1.000	-.077	-.223	-.287	-.153	-.226
2	-.077	1.000	-.187	-.258	-.390	-.318
3	-.223	-.187	1.000	.122	.117	.119
4	-.287	-.258	.122	1.000	.157	.159
5	-.153	-.390	.117	.157	1.000	.170
6	-.226	-.318	.119	.159	.170	1.000

Residuals between observed RV and commercial CPUE (log transformed) and the predicted RV and CPUE by age and year.

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
RV 6	-.762	-.011	.084	.977	-.077	.082	.596	-.433	-.069	-.944	-.153
RV 7	.113	-1.027	.814	-.027	-.043	-.177	.634	-.267	-.688	-1.095	.730
RV 8	.291	-.011	.504	.687	-.179	-.374	-.175	-.158	-.675	-.348	.653
CPUE Age Agg.	-.143	.234	-.048	.433	.477	-.180	-.244	.193	.578	-.009	-.371

	1985	1986	1987
RV 6	.593	.117	.921
RV 7	.460	-.017	.591
RV 8	.204	-.962	.542
CPUE Age Agg.	-.025	.017	-.465

Table 27. FISHING MORTALITY MATRIX FOR 4VWX5 POLLOCK

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
2	.011	.008	.006	.001	.004	.035	.016	.007	.004	.002	.001	.008	.003	.010
3	.217	.076	.084	.052	.035	.167	.106	.165	.065	.054	.033	.043	.054	.081
4	.297	.241	.231	.205	.145	.240	.230	.294	.196	.209	.137	.102	.143	.184
5	.331	.378	.406	.289	.316	.270	.358	.392	.316	.248	.287	.223	.227	.275
6	.392	.476	.382	.420	.381	.313	.424	.455	.496	.259	.262	.408	.322	.337
7	.331	.596	.538	.527	.589	.261	.401	.571	.497	.305	.192	.527	.420	.313
8	.520	.374	.301	.574	.667	.287	.252	.449	.614	.353	.207	.307	.355	.356
9	.414	.372	.090	.393	.864	.368	.295	.261	.518	.544	.188	.197	.341	.337
10	.477	.821	.111	.259	.564	.291	.468	.411	.382	.531	.376	.315	.356	.337
11	.382	.539	.480	.553	.615	.273	.357	.540	.539	.331	.203	.487	.417	.333

Table 28. BEGINNING OF YEAR POPULATION NUMBERS FOR 4VWX5 POLLOCK

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
2	26892	36867	46756	59978	36091	9742	24905	104773	70995	50612	77828	33273	25022	10617
3	41527	21781	29949	38069	49055	29444	7705	20064	85148	57903	41352	63662	27017	20432
4	14822	27366	16534	22539	29584	38762	20409	5672	13935	65348	44935	32773	49948	20951
5	11908	9018	17612	10746	15034	20947	24961	13273	3459	9378	43399	32092	24228	35448
6	4631	7004	5062	9612	6587	8977	13098	14282	7342	2066	5992	26671	21029	15807
7	1583	2563	3563	2828	5173	3686	5374	7018	7422	3659	1305	3774	14525	12481
8	582	931	1156	1703	1367	2350	2325	2947	3248	3696	2209	882	1825	7811
9	312	283	524	701	785	574	1443	1480	1541	1438	2127	1470	531	1047
10	293	169	160	392	387	271	325	879	933	751	683	1443	988	309
11	282	149	61	117	248	181	166	167	478	521	362	384	862	566

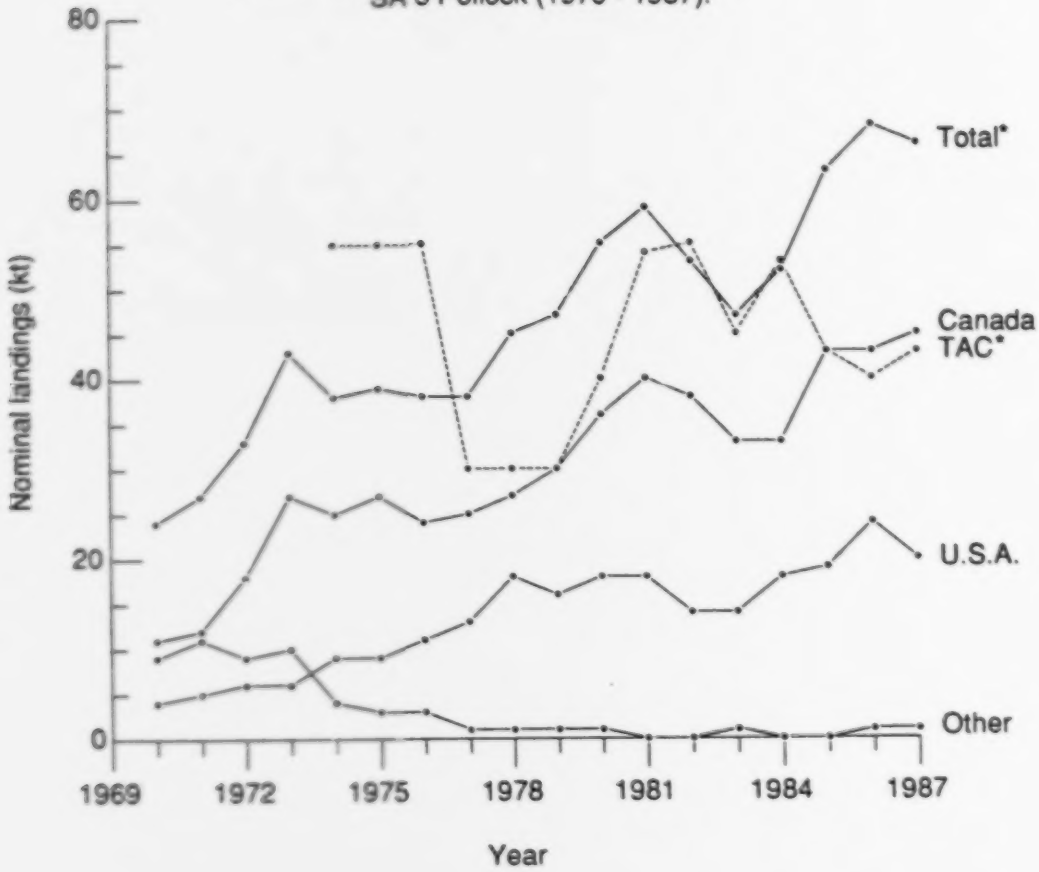
Table 29. MEAN POPULATION BIOMASS(MT) FOR 4VWX5 POLLOCK

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
2	19979	28550	25300	45175	27553	6336	21303	58774	38390	33609	72712	20936	18210	6857
3	47415	24375	32109	38086	53850	29248	9232	24647	84686	59371	54184	58686	28303	20088
4	22835	43988	25613	29646	45015	51515	32375	11110	29355	89370	82193	54505	78202	33724
5	27798	20983	36566	22121	31492	45508	53275	29524	9476	23156	90465	72064	51021	72507
6	14297	19620	14148	25315	19751	24803	34184	35968	21951	6892	16854	64592	55742	37185
7	6212	8995	11605	9161	16551	13746	17005	21438	24119	14014	5557	10029	41607	37861
8	2539	4617	5046	6720	5294	10518	10569	12645	11725	14693	10436	3564	6771	25726
9	1551	1623	3188	3600	3185	2955	7372	7983	6892	6095	10549	7708	2570	4208
10	1564	796	1061	2220	1833	1599	1832	4896	5188	3582	3384	7128	5173	1713
11	1823	873	377	724	1285	1177	1001	907	2630	3115	2239	1844	4306	3239

Table 30. Divisions 4VWX + Subarea 5 pollock projections for 1989 assuming a 1988 catch of 63,000 t and fishing at $F_{0.1}$ in 1989.

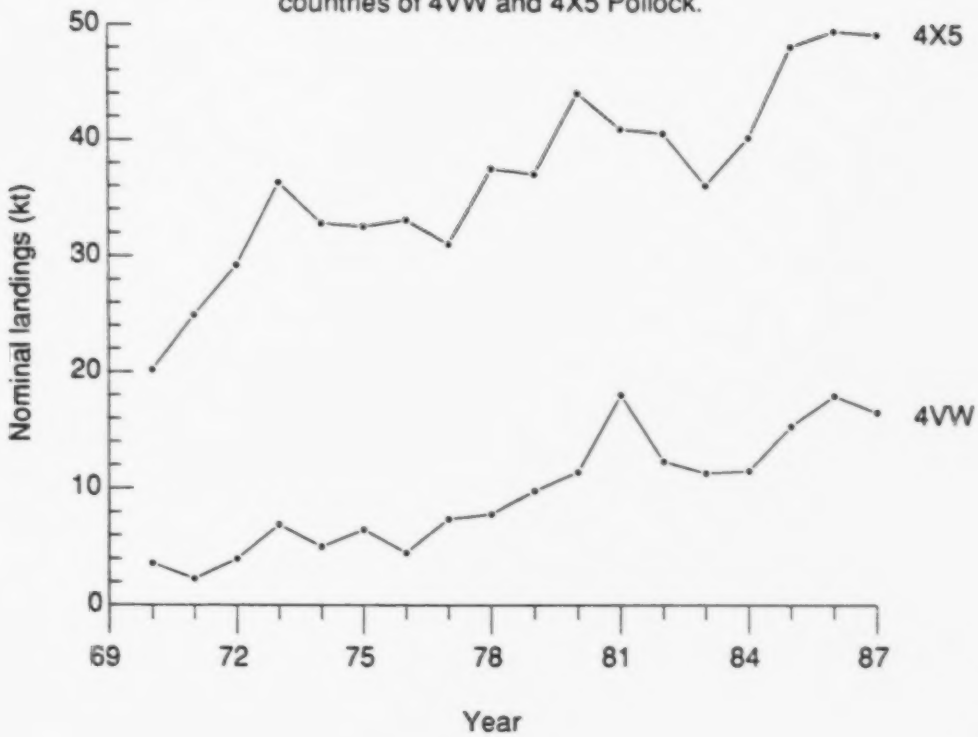
Age	Population Numbers ('000)	Catch Biomass (t)	Population Biomass (t)	Fishing Mortality
2	40,000	142	26,758	.005
3	32,511	1,465	32,389	.045
4	25,129	4,476	41,302	.108
5	10,882	4,317	23,793	.181
6	9,111	6,186	23,478	.263
7	12,570	10,678	38,134	.280
8	5,151	5,452	19,472	.280
9	4,164	5,491	19,609	.280
10	2,497	3,759	13,424	.280
11	341	524	1,872	.280

Figure 1. Nominal landings of Div. 4VWX + SA 5 Pollock (1970 - 1987).



*Canadian allocation only from 1985 on.

Figure 2. Nominal landings for all countries of 4VW and 4X5 Pollock.



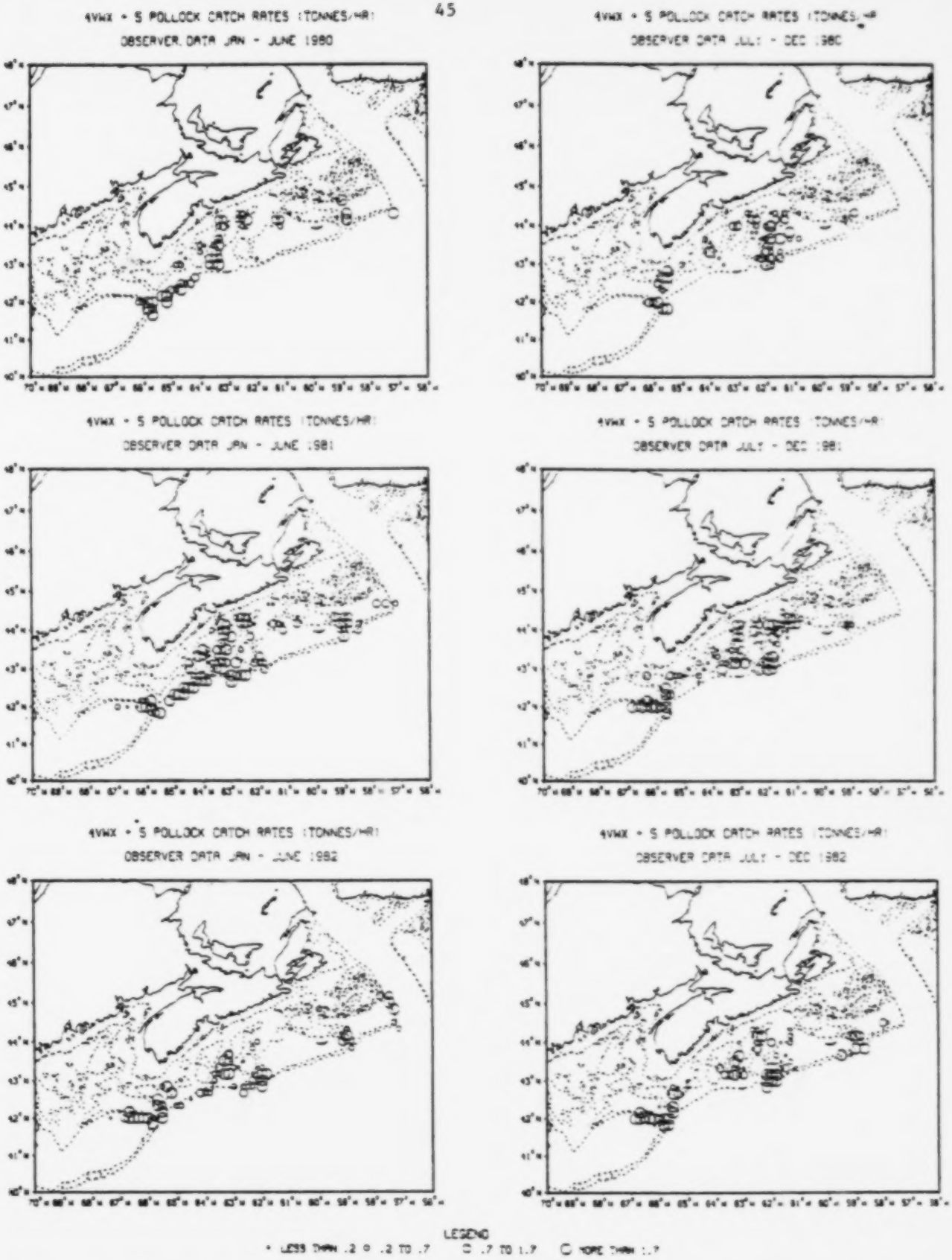


Figure 3. International Observer plots of catch rates for pollock (Jan.-June; July-Dec.; 1980-1987).

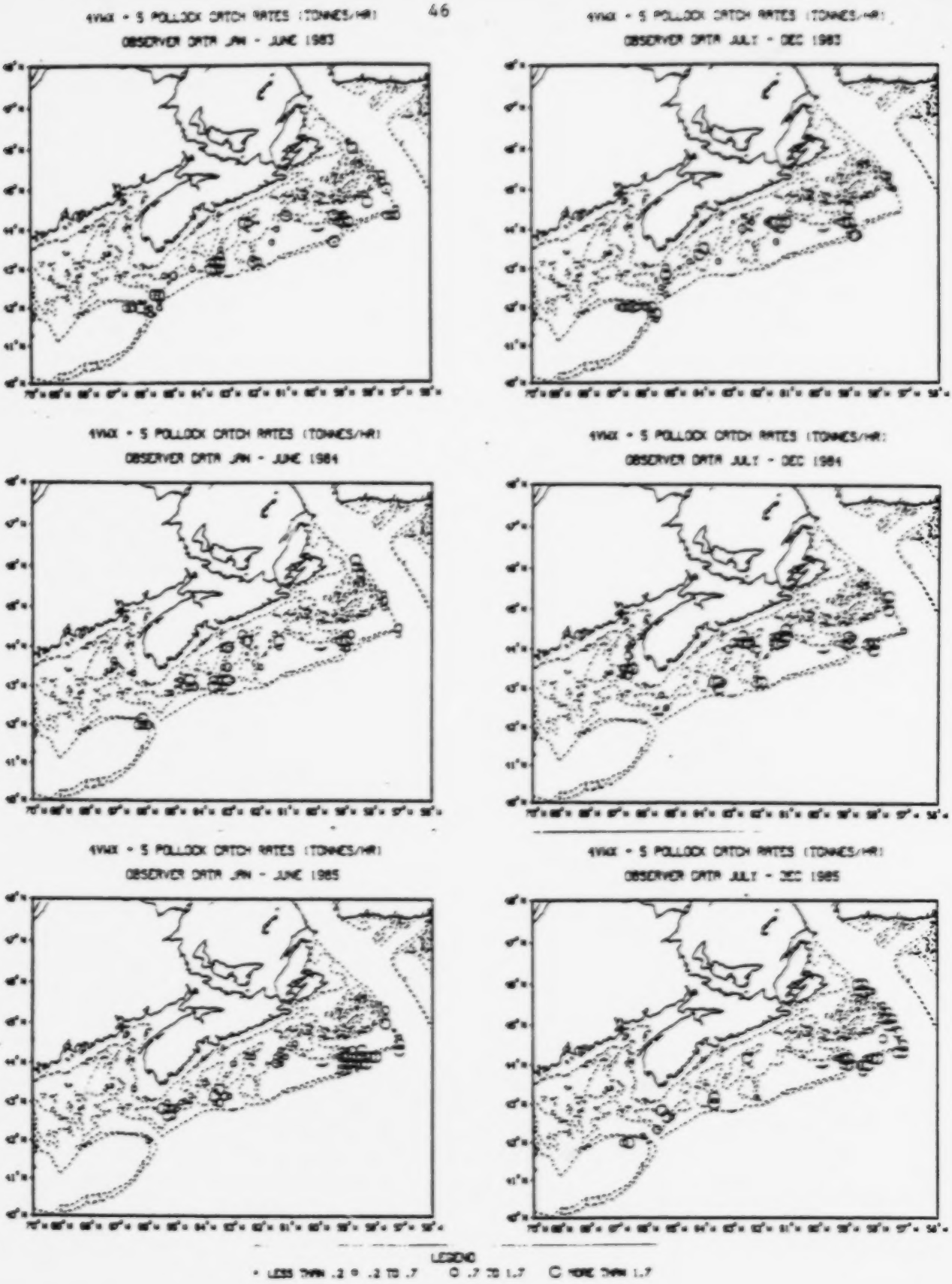


Figure 3. (Continued).

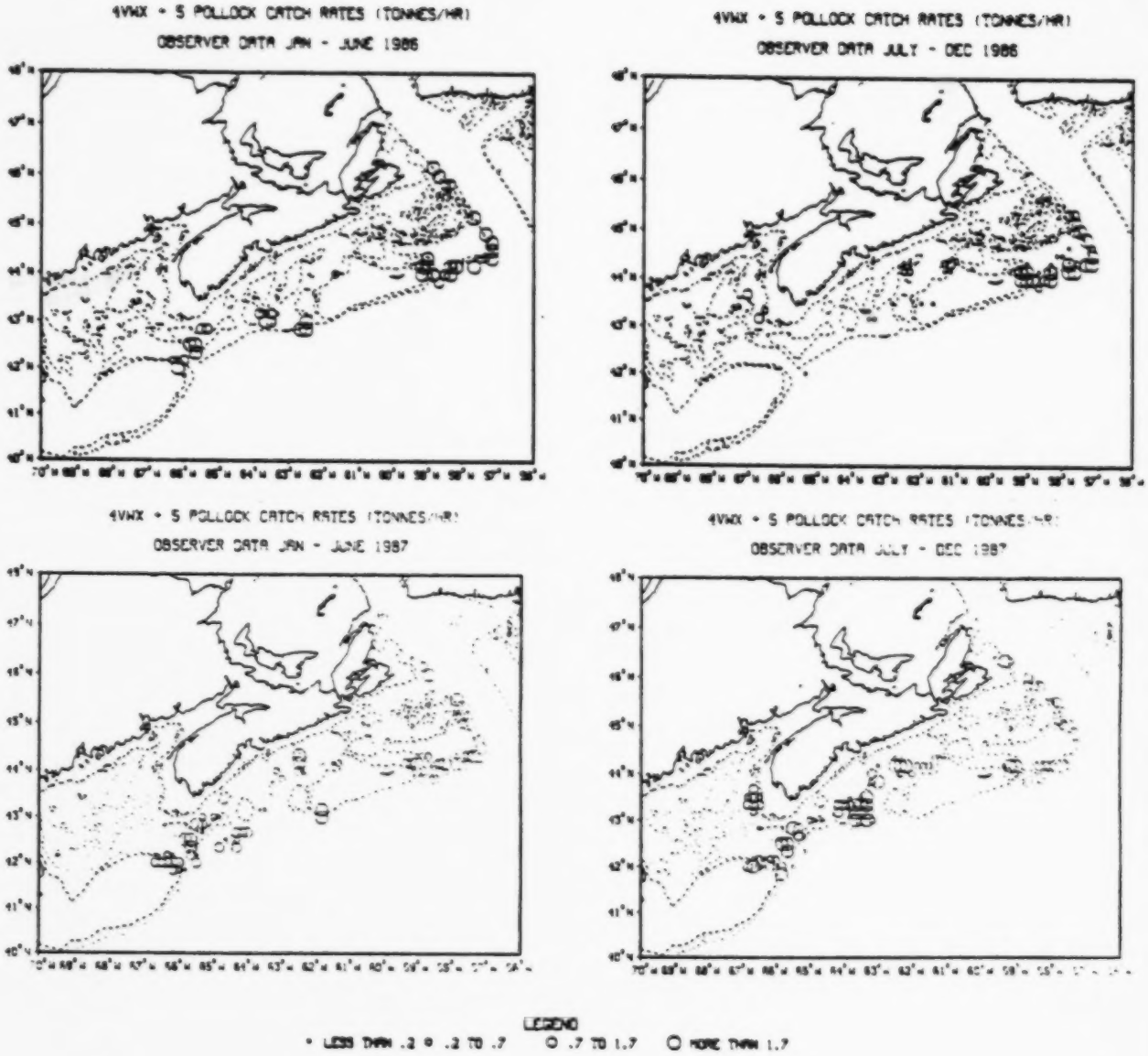
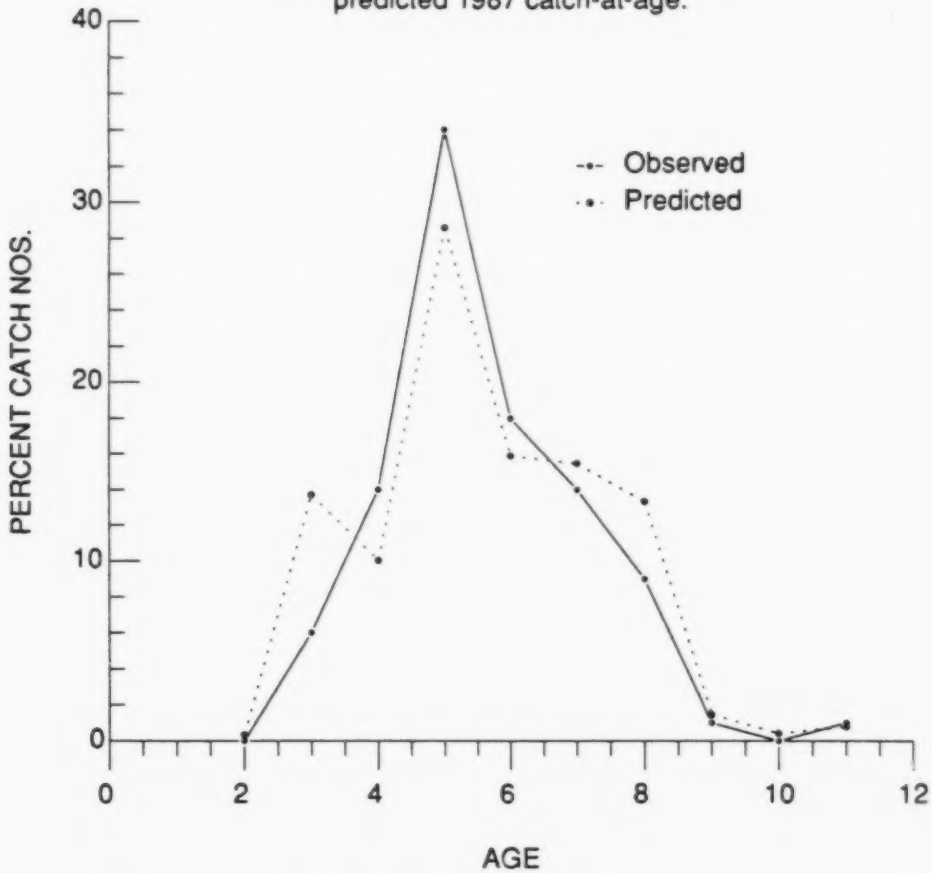


Figure 3. (Continued).

Figure 4. Comparison of observed and predicted 1987 catch-at-age.



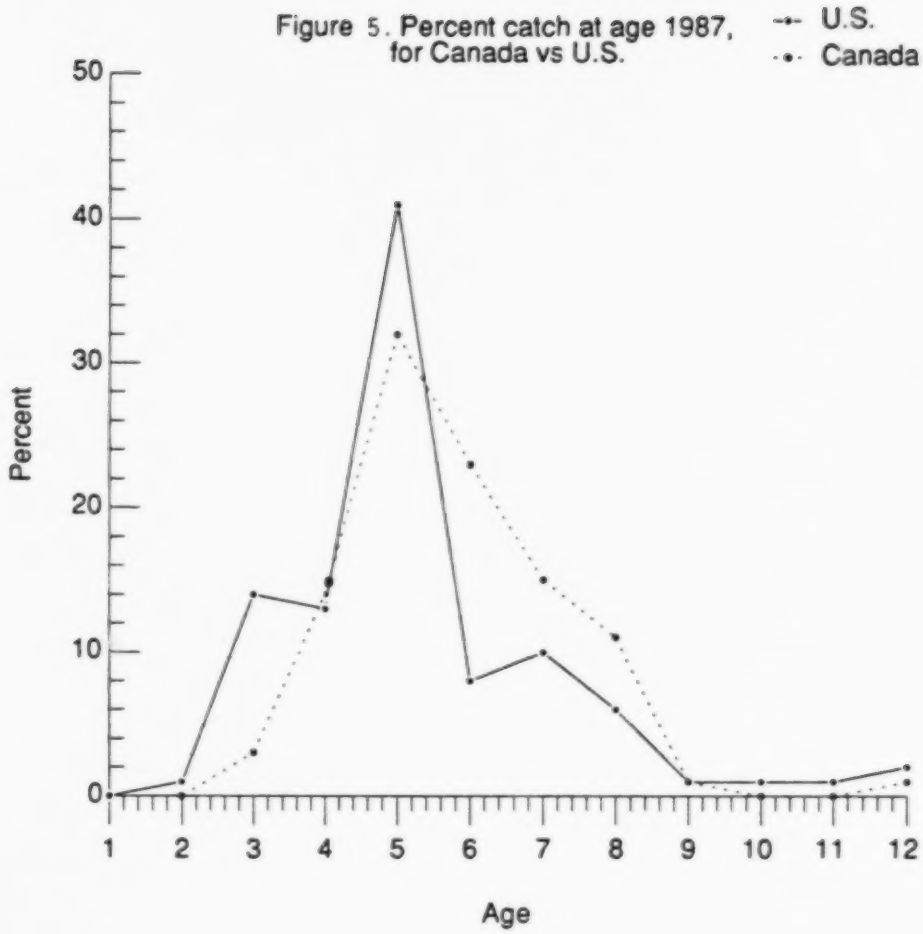


Figure 5. Percent catch at age 1987, for Canada vs U.S.

Figure 6. Comparison of Canadian 4VW and 4X5 % catch at age for large trawlers

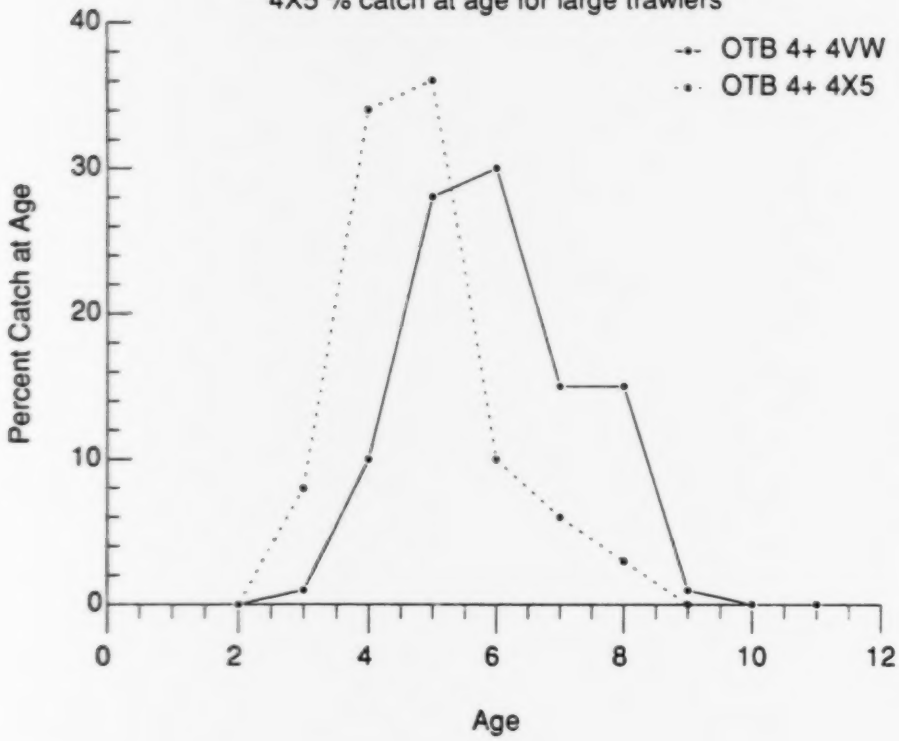
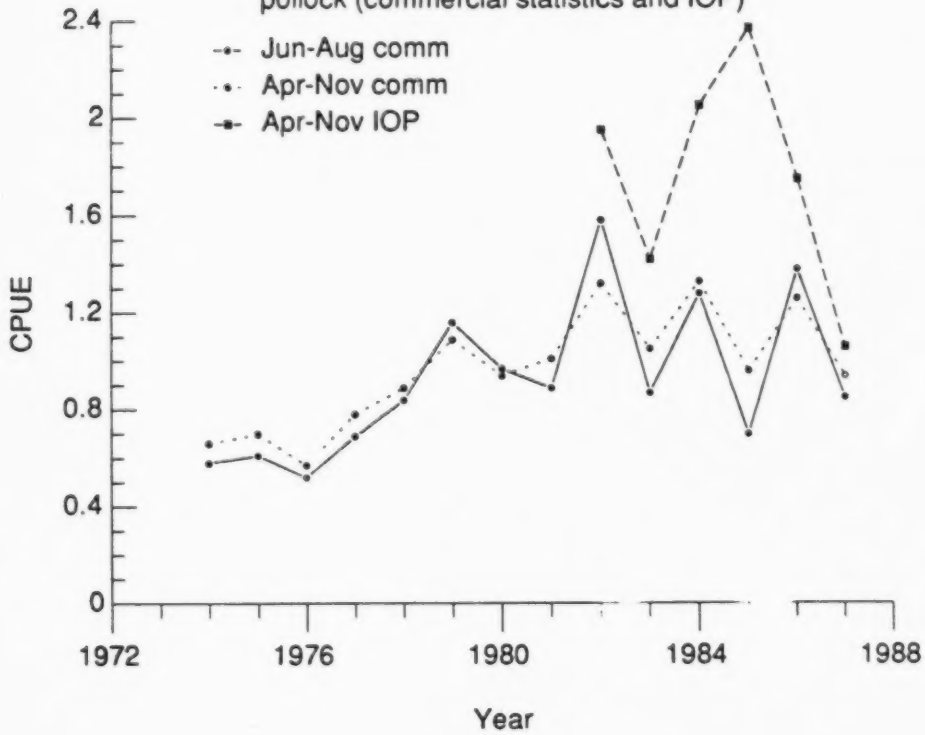


Figure 7. Catch rate indices for 4VWX5 pollock (commercial statistics and IOP)



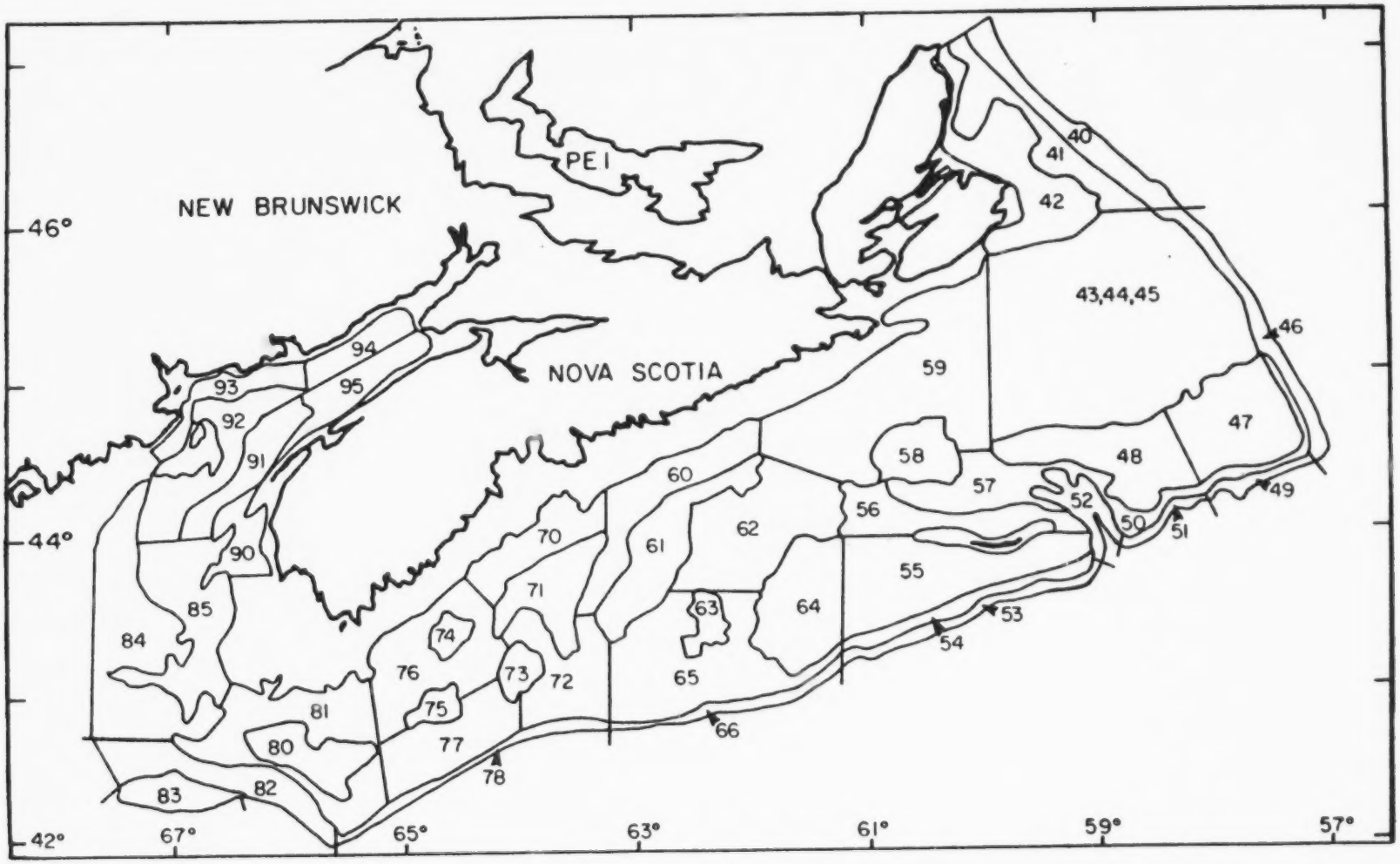


Figure 8. Stratification used for Canadian RV bottom trawl surveys (Divisions 4VWX + Subarea 5).

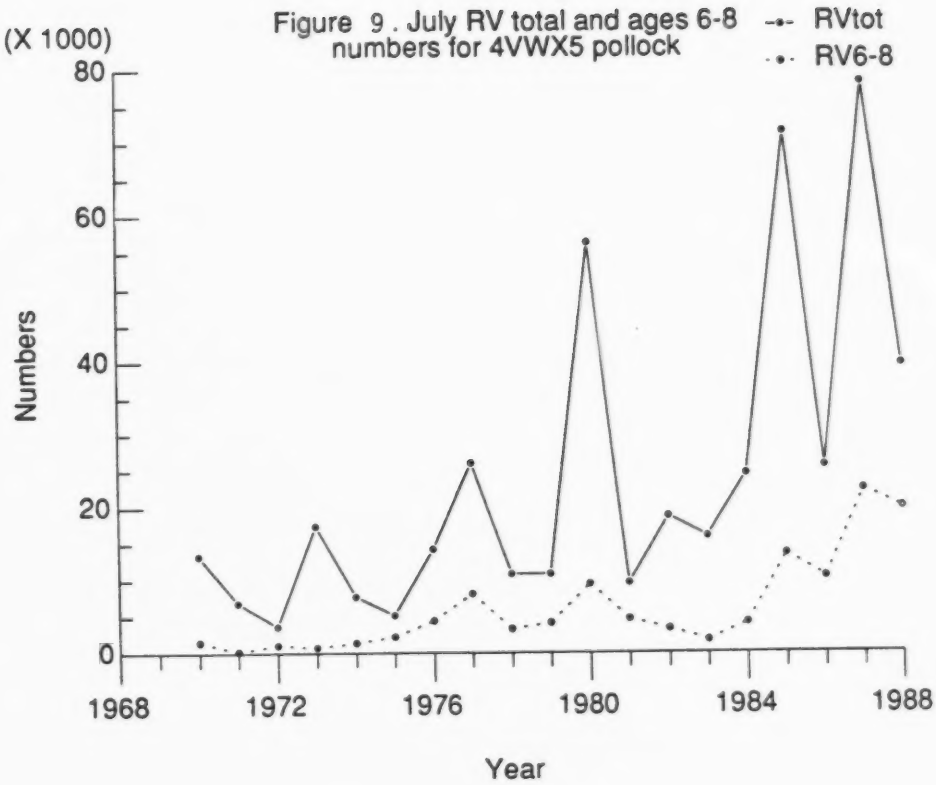


Figure 9 . July RV total and ages 6-8 numbers for 4VWX5 pollock

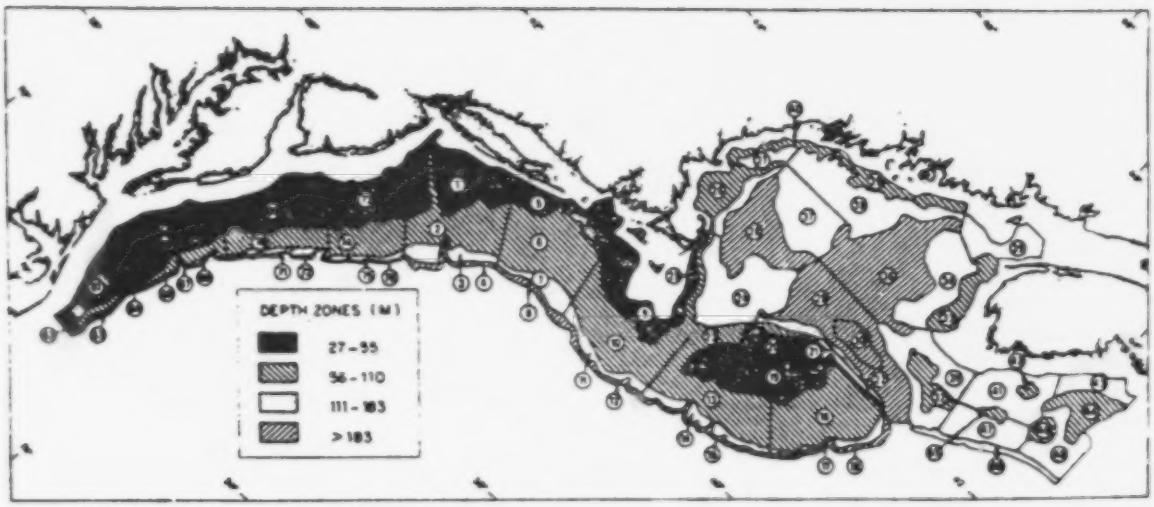


Figure 10. Stratification used for USA RV bottom trawl surveys.

Figure 11a. Survey numbers per tow VS SPA numbers. Ages 6, 7, and 8.

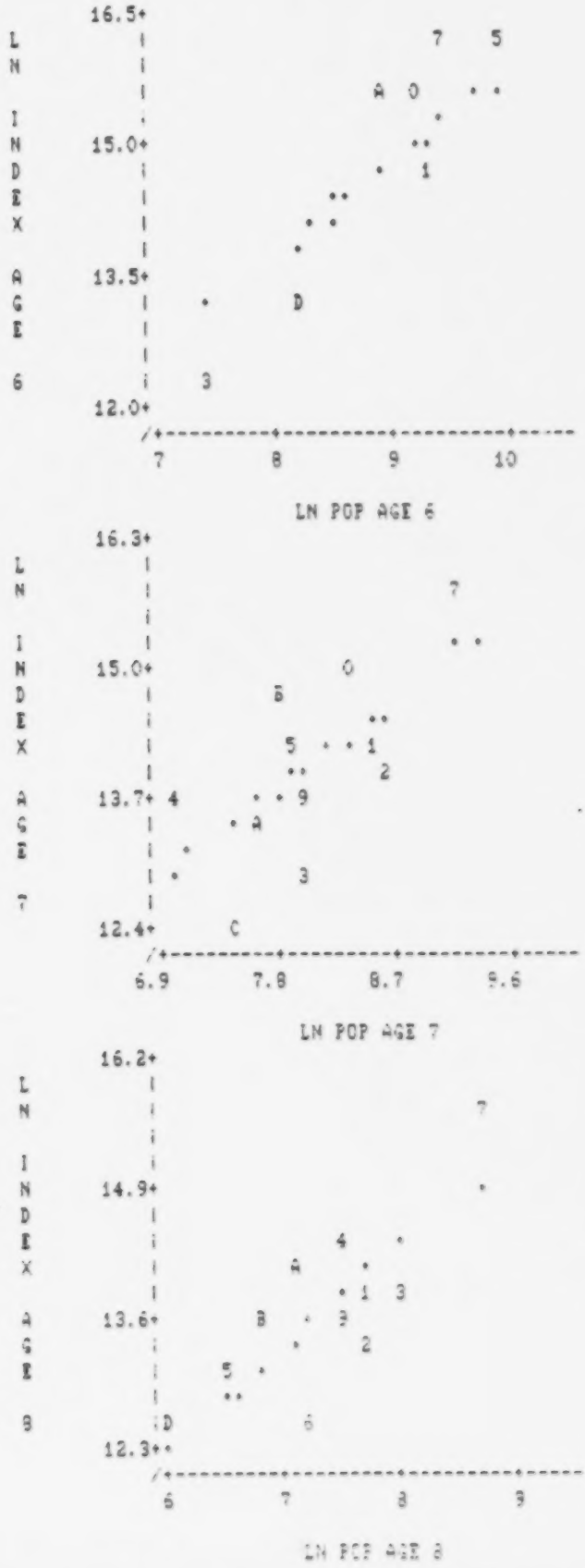


Figure 11b. Trends in residuals over time. Ages 6, 7, and 8.

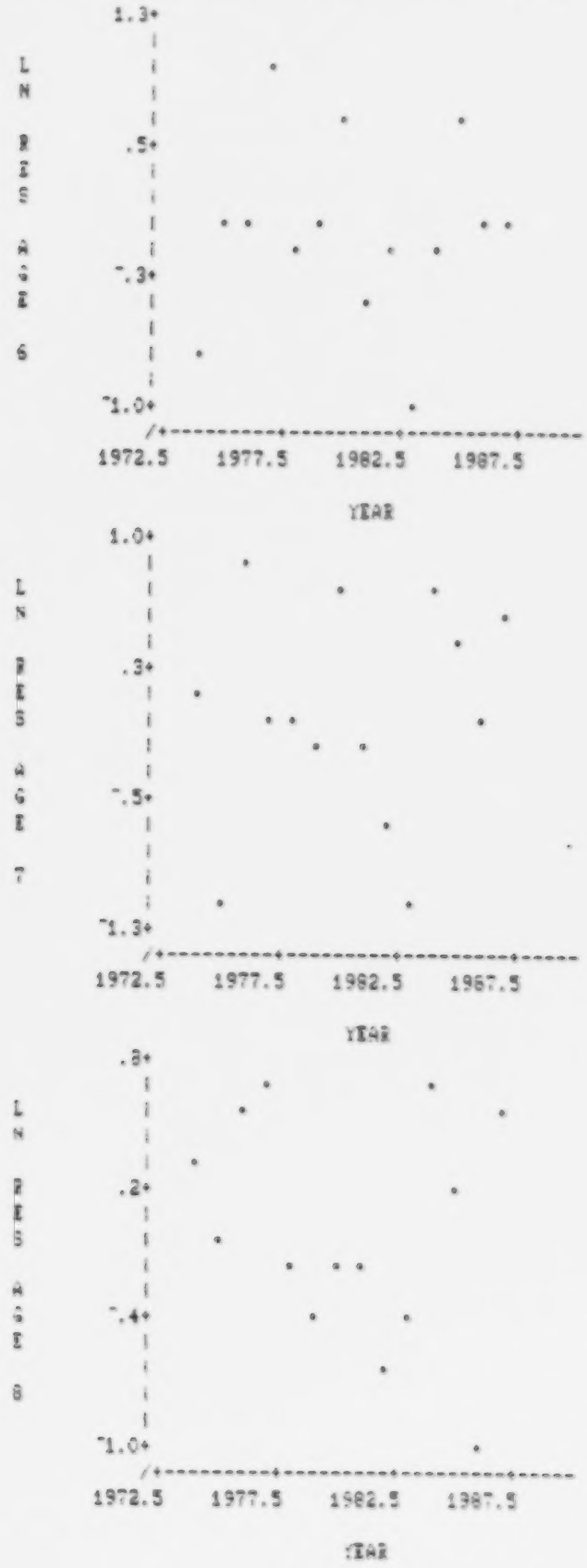


Figure 11c. Age aggregated tuning plots resulting from ADAPT. OTB CPUE VS SPA fishable biomass.

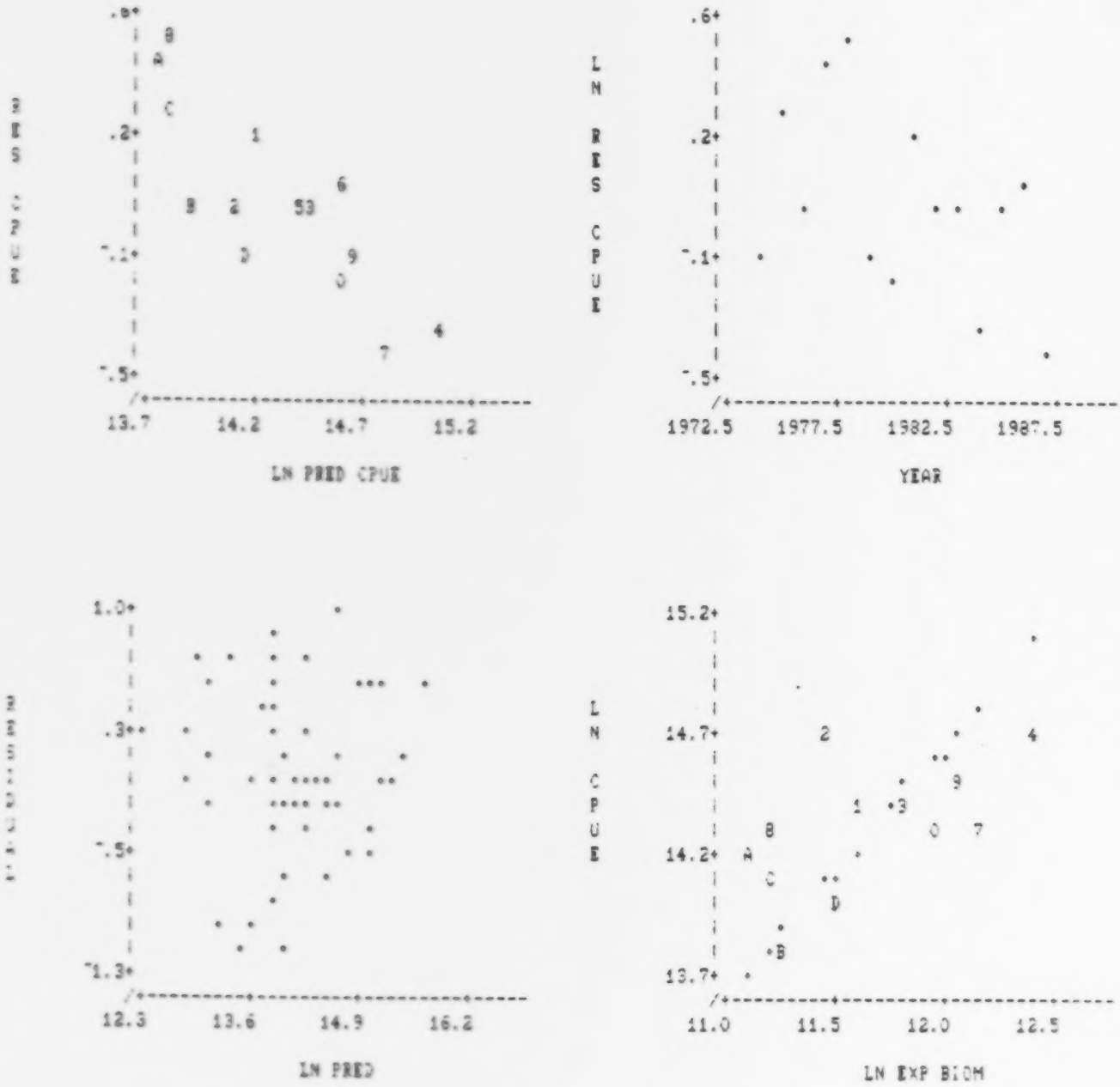


Figure 11d. Trend in LN residuals VS LN predicted value.

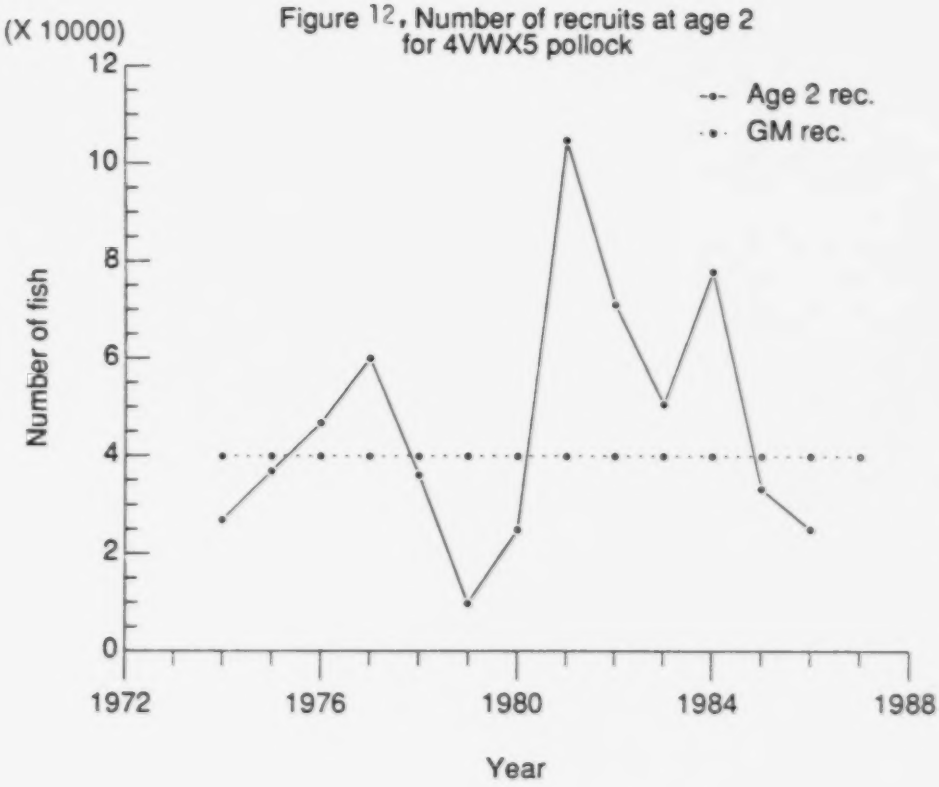
```
          1.3+
             |
             |                A
R            |
E            |                   0       5
S          .5+
             |
A            |
G            |          B  C  9     7  6
E            |            48
          ¯.3+
             |                    1
6            |
             |         D
             |
         ¯1.0+  3
             /+---------+---------+---------+-----
             13        14        15        16

                         LN PRED AGE 6
          1.0+
             |          B
             | 4              0
R            |                          7
E            |           5
S          .3+
             |  D
A            |        A     8           6
G            |            9     1
E            |
          ¯.5+
             |                   2
7            |
             |
             |      C     3
         ¯1.3+
             /+---------+---------+---------+-----
           12.9      13.8      14.7      15.6

                         LN PRED AGE 7
           .8+
             |           A    4
             |         B                   7
R            |
E            | D
S          .2+      5
             |
A            |      C
G            |         8      0 1
E            |
          ¯.4+                9   3
             |
8            |                  2
             |
             |
         ¯1.0+              6
             /+---------+---------+---------+-----
          12.25     13.25     14.25     15.25

                         LN PRED AGE 8
```

Figure 12. Number of recruits at age 2 for 4VWX5 pollock



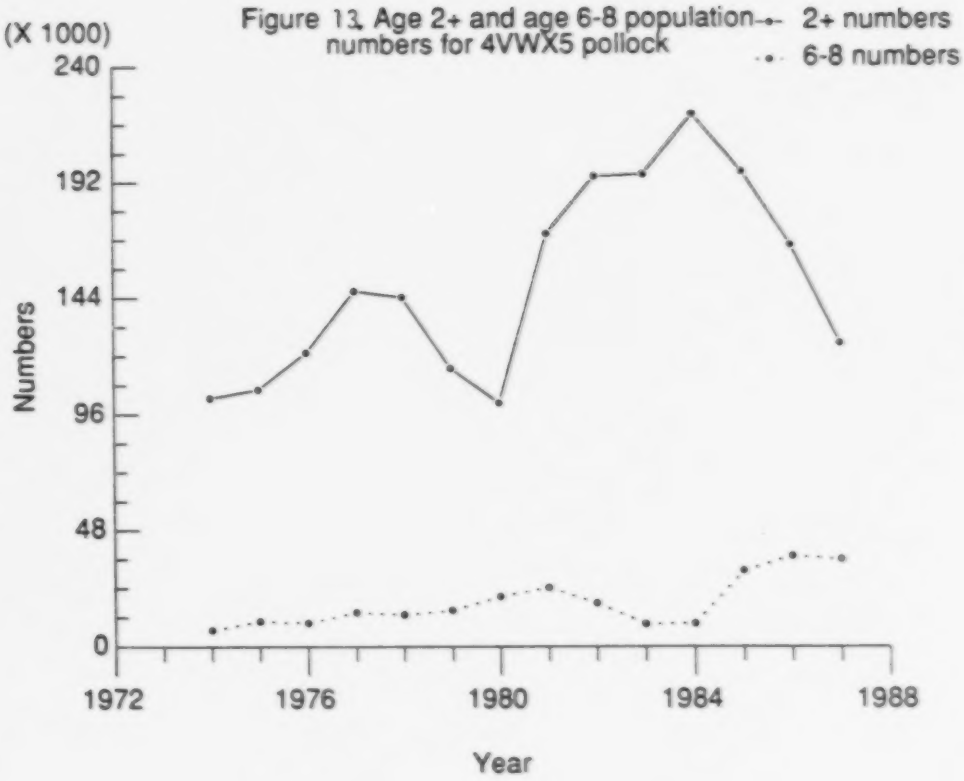


Figure 13. Age 2+ and age 6-8 population numbers for 4VWX5 pollock

Appendix I.

```
    ∇ R←DIFFΔOBJ;DELTA;I;TPAR
[1]  ⍝ CALCULATES ONE SIDED DIFFERENCE OF OBJECTIVE FUNCTION
[2]   I←1
[3]   R←(N,0)⍴1
[4]   DELTA←(0.01×par)+0.01×par=0
[5]  L1:TPAR←((I-1)↑par),(par[I]+DELTA[I]),I↓par
[6]   R←R,(e-OBJΔFN TPAR)÷DELTA[I]
[7]   →L1×P≥I←I+1
```

```
    ∇ R←DIFFΔPNLTY;I;R1;DELTA;TPAR;fpnlty;bpnlty
[1]  ⍝ CALCULATES FIRST AND SECOND DIFFERENCES OF PENALTY FUNCTION
[2]   I←1
[3]   R← 2 0 ⍴0
[4]   DELTA←(0.01×PAR)+0.01×PAR=0
[5]  L1:TPAR←((I-1)↑PAR),(PAR[I]+DELTA[I]),I↓PAR
[6]   R1←(pnlty-fpnlty←alpha PNLTYΔFN TPAR)÷DELTA[I]
[7]   TPAR←((I-1)↑PAR),(PAR[I]-DELTA[I]),I↓PAR
[8]   bpnlty←alpha PNLTYΔFN TPAR
[9]   R←R,,R1,(fpnlty-bpnlty-2×pnlty)÷DELTA[I]
[10]  →L1×P≥I←I+1
```

```
    ∇ R←W EXPΔBIOM POPN;PR
[1]   PR←f÷(⍴f)⍴f[10;]
[2]   R←+⌿POPN×W×PR
```

```
    ∇ R←PR FILL V;AG;N;C;AGES;F
[1]   AG←⍴PR ⍝ NUMBER OF AGES
[2]   N←⍴V ⍝ NUMBER OF AGES BEING ESTIMATED
[3]   C←,(AG,¯1)↑c ⍝ CATCH IN LAST YEAR
[4]   AGES← 7 S ⍝ ROW INDEX FOR AGES BEING ESTIMATED * USER TO MODIFY *
[5]   F←(⍟((V×*m)+C[AGES-1]×*m÷2)÷V)-m
[6]   F←(PR[AGES-1]=1)/F
[7]   F←PR×(+/F)÷⍴F
[8]   R←¯1↓((C×F+m)÷F×(1-*-F+m))×*-F+m
[9]   R[AGES-1]←V ⍝ INDEX SHIFTED SINCE FIRST AGE IS TO BE CATENATED
```

```
    ∇ R←FRGNΔFN A
[1]  ⍝ THIS FUNCTION SHOULD RETURN A 1 IF THE PARAMETERS
[2]  ⍝ ARE IN THE FEASIBLE REGION AND 0 OTHERWISE
[3]   R←^/(A>lbnd),A<ubnd
```

```
    ∇ IPRINT;TMP
[1]   2 1 ⍴' '
[2]   TMP← 3 6 ⍴'LAMBDARSS   NPHI  '
[3]   '10A1,E15.8' ⎕FMT(3 10 ↑TMP;a¯1↓,TMP,',')
[4]   ' '
[5]   'par'
[6]   ,'E15.8' ⎕FMT par
```

Appendix I. (Continued)

```
    ∇ Z←PARTΔRE;
[1]   A MEAN POPULATION PR FOR LAST 3 YEARS
[2]   LOOP:
[3]    Z←COHORT 0.5
[4]    wf←f×POp
[5]    mf←(+/[1] 7 0 ↓wf)÷+/[1] 7 0 ↓POp
[6]    prm←f÷ 13 17 ρmf
[7]    Z←(+/ 0 ¯1 ↓ 13 ¯4 ↑prm)÷3
[8]    PR[⍳6]←6↑Z
[9]    5 2 ⍕Z
[10]   ⎕
[11]   →LOOP
```

```
    ∇ PARΔSE;N;P;HESS;de;NORM
[1]    'APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION'
[2]    ' '
[3]    N←ρ,e
[4]    P←ρ,par
[5]    de←DIFFΔOBJ
[6]    HESS←2×(⍉de)+.×de
[7]    NORM←(+/HESS*2)*0.5
[8]    HESS←⌹HESS÷(ρHESS)ρNORM
[9]    HESS←2×msr×HESS÷⍉(⍉ρHESS)ρNORM
[10]   parΔse←(1 1 ⍉HESS)*¯0.5
[11]   corr←HESS÷HESS×parΔse∘.×parΔse
[12]   parΔse←÷parΔse
[13]   'ORTHOGONALITY OFFSET.........',,'F16.3' ⎕FMT con
[14]   'MEAN SQUARE RESIDUALS .......',,'F16.6' ⎕FMT msr
```

```
    ∇ R←alpha PNLTYΔFN A
[1]   A THE PENALTY FUNCTION FOR THE CONSTRAINTS
[2]   A R IS THE RESULTANT MAGNITUDE
[3]   A A IS THE VECTOR OF PARAMETERS
[4]   A alpha IS THE VECTOR OF CONSTANTS FOR THE CONSTRAINTS
[5]    R←+/alpha÷(A-lcnstrnt),ucnstrnt-A
```

```
    ∇ R←POPN RESI K
[1]    R←POPN[5 6 7 ;]
[2]    ihat←⌹(⍉(⍉ρR)ρK)×R A PREDICTED MATRIX FOR INDEX
[3]    R←i-ihat A WEIGHTED RESIDUALS
```

```
    ∇ R←POPN RESI2 K
[1]    R←weight EXPΔBIOM POPN
[2]    ihat2←⌹K×R A PREDICTED MATRIX FOR INDEX
[3]    R←i2-ihat2 A WEIGHTED RESIDUALS
```

```
    ∇ R←ROWS SPAS B;J;AG;YR;F
[1]   A ASSUMES LAST ROW IS NOT A PLUS GROUP
[2]   A ASSUMES F IN LAST AGE GROUP EQUAL TO AVERAGE FOR ROWS
[3]    AG←1↑ρc A NUMBER OF AGE GROUPS
[4]    YR←1+¯1↑ρc A NUMBER OF YEARS
[5]    R←(AG,YR)ρ0 A INITIALIZE MATRIX
```

Figure 14. Age 2+ fishable biomass for 4VWX5 pollock

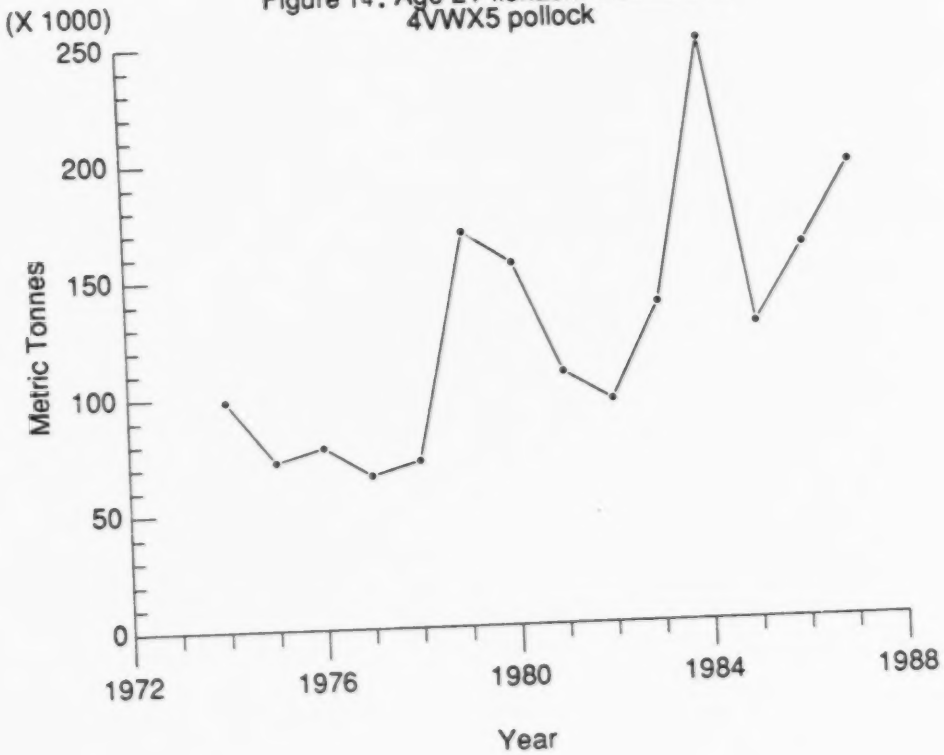
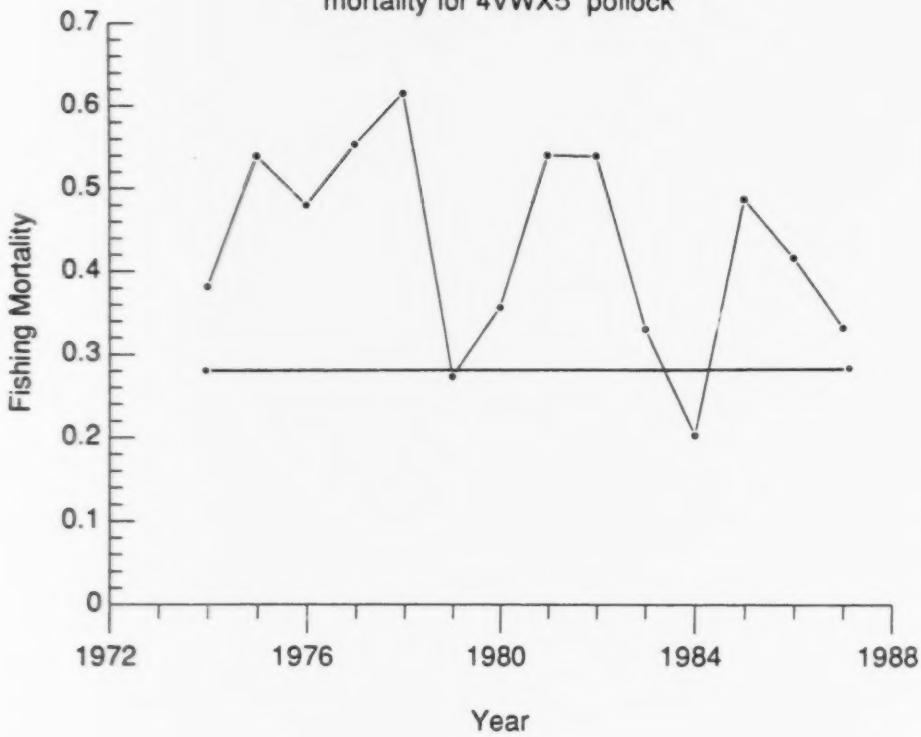


Figure 15. Mean fully recruited fishing mortality for 4VWX5 pollock



Appendix I. (Continued)

```
      ∇ NLLS;BOOL;J;DIAG;Q;LAMBDA;HESS;par;PAR;PHI;de;CAUSE;I;V;NPHI;RHI;dpnlty;dpnlty;Q;HESS;J
[1]   ⍝ NON-LINEAR LEAST SQUARES USING MARQUARDT ALGORITHM
[2]    P←⍴par←PAR←,initial
[3]    RSS←e+.×e←OBJΔFN PAR ⍝ RESIDUAL SUM OF SQUARES
[4]    N←⍴,e
[5]    pnlty←alpha PNLTYΔFN PAR ⍝ PENALTY FOR CONSTRAINTS
[6]    NPHI←PHI←RSS+pnlty
[7]    LAMBDA←0.01
[8]    BOOL←(P,P)⍴1,P⍴0 ⍝ USED TO CREATE DIAG MATRIX
[9]    con←10
[10]   IPRINT
[11]   J←1
[12]  L3:→(limit<J←J+1)/L5 ⍝MAIN LOOP
[13]   PAR←par
[14]   PHI←NPHI
[15]   de←DIFFΔOBJ
[16]   Q←2×e+.×de ⍝ GRADIENT
[17]   HESS←2×(⍉de)+.×de ⍝ HESSIAN
[18]   dpnlty←DIFFΔPNLTY ⍝ DIFFERENCE FOR PENALTY
[19]   Q←Q+dpnlty[1;]
[20]   DIAG←,1 1 ⍉HESS←HESS+(2×PAR)×BOOL\dpnlty[2;]
[21]   LAMBDA←1E⍣6⌊LAMBDA×0.01
[22]   I←1
[23]   SHESS←HESS+(2×P)×BOOL\DIAG×LAMBDA←LAMBDA×10 ⍝ MARQUARDT METHOD
[24]   NORM←(+/SHESS*2)*0.5 ⍝ COLUMN NORMS
[25]   SHESS←SHESS÷(⍉SHESS)×NORM ⍝ SCALE HESSIAN
[26]   par←PAR+V←(Q⌹SHESS)÷NORM ⍝ STEP DIRECTION; STEP SIZE=1
[27]   →(~FRGNΔFN par)/L4
[28]   RSS←e+.×e←OBJΔFN par
[29]   pnlty←alpha PNLTYΔFN par
[30]   →(PHI≥NPHI←RSS+pnlty)/L6
[31]  L4:LAMBDA←LAMBDA×100
[32]  L5:par←PAR+V←V×0.1*I ⍝INNER LOOP  REDUCE STEP SIZE
[33]   →(10<I←I+1)/L6
[34]   →(~FRGNΔFN par)/L5
[35]   RSS←e+.×e←OBJΔFN par
[36]   pnlty←alpha PNLTYΔFN par
[37]   →(PHI≥NPHI←RSS+pnlty)/L6
[38]   →L3
[39]  L6:IPRINT
[40]   msr←RSS÷N-P
[41]   →(1=⍲CAUSE←(100×I),(limit≤J),(1E⍣3<con+((N-P)×Q+.×V)÷P×RSS)×0.5),(1E⍣5>(NPHI-PHI)÷PHI),
1E⍣5>,/(par-PAR)÷1E⍣20+(PAR))/L3
[42]   (⍲CAUSE)/[1]exit
```

```
      ∇ r←OBJΔFN A
[1]    s←0.pr FILL 2⍴A ⍝ SURVIVORS AT DESIGNATED AGE
[2]   As←bool\s
[3]   As[(~bool)/⍳⍴bool]←350 100
[4]    x←GAG↑2↓A ⍝ CALIBRATION COEFFICIENTS
[5]    x2←5↓A ⍝ COEF FOR CPLE
[6]    pop← 6 7 8 GPAS s ⍝ CALCULATE POPULATION NUMBERS
[7]    f←(⍉(0 ¯1 ⍉pop)-((0 ¯1 ⍉pop)×x-w)-(0 ¯1 ⍉pop)×x-2)-w
[8]    popΔmid←(0 ¯1 ⍉pop×(1-x-f+w)-f+w
[9]    ei←popΔmid REGI x ⍝ CALCULATE INDEX RESIDUALS
[10]   ei2←popΔmid REGI x2 ⍝ CALCULATE CPUE RESIDUALS
[11]   ei1←popΔmid REGI f ⍝ CALCULATE CATCH RESIDUALS
[12]   r←,(,ei1),ei2 ⍝ ,ei ⍝ REMOVE COMMENT FOR CATCH EFFECT
```